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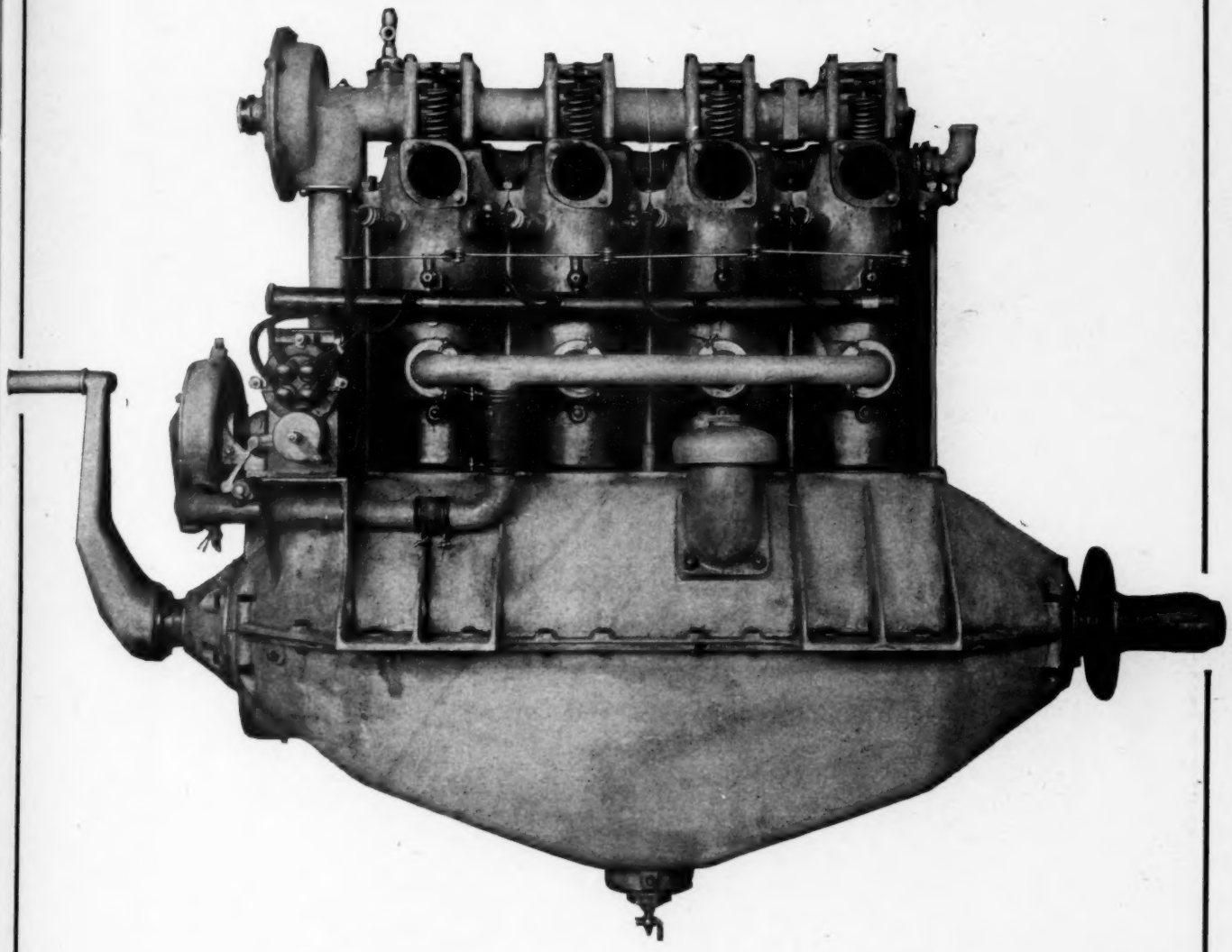

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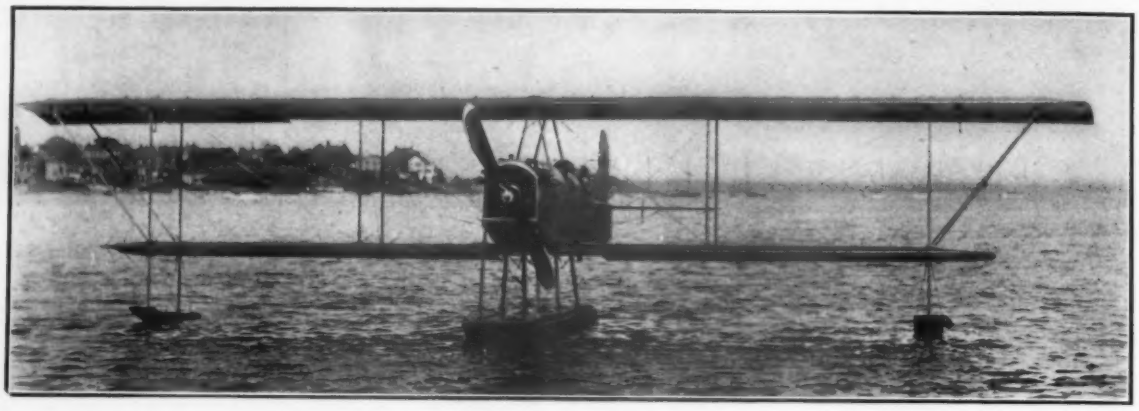

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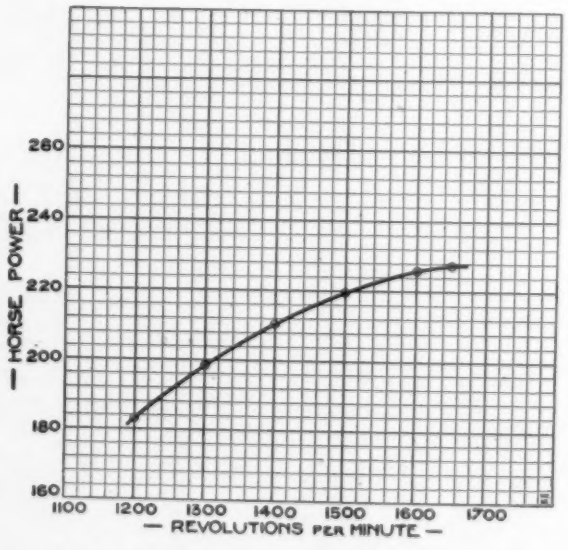

Duration of test (minutes)	60
Average R.P.M.	1403.33
Average load on scales (lbs.)	449.64
Average horsepower	**210.26**
Maximum observed horsepower	210.50
Minimum observed horsepower	208.10
Total Gas. consumption (lbs.)	111.30
Total Gas. consumption (U. S. gals.)	18.10
Gas. consumption per hour (lbs.)	111.30
Gas. consumption per hour (U. S. gals.)	18.10
Gas. consumption (lbs. per H. P. hour)	**.528**
Total Oil consumption (lbs.)	6.50
Total oil consumption (U. S. gals.)	.844
Oil consumption (U. S. gals. per hour)	**.844**
Oil pressure—start of test (lbs.)	71.00
Oil pressure—end of test (lbs.)	72.00
Oil pressure—maximum test (lbs.)	74.00
Oil pressure—minimum test (lbs.)	68.00
Average inlet water Temp. (F.)	116.90
Average outlet water Temp. (F.)	140.50

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DECEMBER 15, 1916 **AVIATION** VOL. I. NO. 10

AND

AERONAUTICAL ENGINEERING

INDEX TO CONTENTS

	PAGE
Aircraft in Pictures	316
Editorials	317
Possible Improvements in Carrying Capacity of Rigid Air Ships	318
Contracts Let by Army for $2,007,000 Worth of Seaplanes	321
A Time Controlled Aerial Torpedo	322
Lieut. Herbert Dargue Reports on Night Flying	323
The Verville Pusher Type Seaplane	324
The British Aeronautical Situation	325
A Two-Propeller Tractor Model	326
Allies Order 6,275 Hispano-Suiza Engines	327
Course in Aerodynamics and Airplane Design	328
Aeronautical Patents	330
News of the Fortnight	331
$100,000 Asked for Aerial Postal Experimentation	331
Orville Wright's New Stabilizer Almost Perfected	331
Ruth Law Flew at Liberty Illumination	333
Pan-American Aeronautic Exposition	334

THE GARDNER, MOFFAT COMPANY, Inc., *Publishers*

120 WEST 32D STREET NEW YORK

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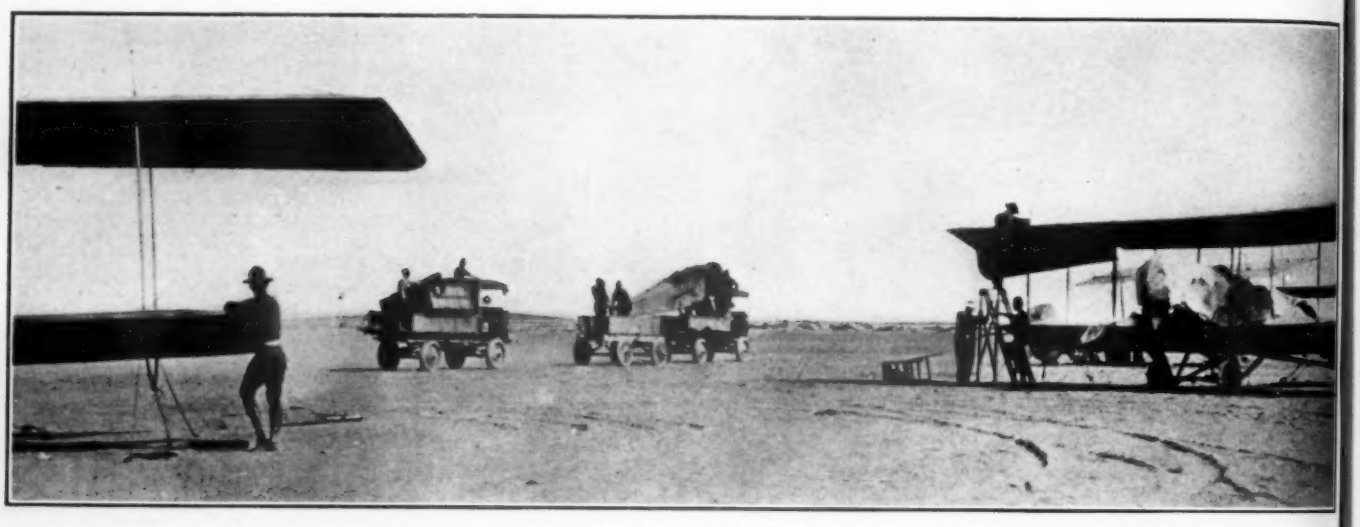
Some Belgian Pursuit Machines in Flanders.



Transporting Machines of the First Aero Squadron, U. S. A., near Columbus, N. M.

Photo by Central News Photo Service

Bringing up a "nurse" balloon. Hydrogen gas generated miles in the rear of where the observation kite balloons are hoverin is brought up to the front line in nurse balloons like this one.

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AVIATION AND AERONAUTICAL ENGINEERING

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Vol. 1 December 15, 1916 No. 10

ONCE more Congress is in session and followers of aeronautics are scrutinizing keenly the proposed appropriations, both military and naval. The Aviation Section of the Signal Corps needs about $16,000,000 for the equipment and maintenance of aero squadrons alone, to carry on the work begun with the appropriation of $13,281,666 last August.

Brigadier-General George P. Scriven, Chief Signal Officer, U. S. A., in his annual report to the Secretary of War, recommends seven regular army squadrons with the mobile army and five with the coast artillery, together with the necessary aerostatic units, and a second line reserve of twelve more heavier than air squadrons. This equipment would mean twenty-four heavier than air squadrons with thirty-six airplanes each and would entail an annual cost of about $16,000,000 for the 864 planes.

Up to last August the manufacturers received practically no governmental encouragement. The urgent deficiency act of March 31, 1916, gave the Aviation Section of the Signal Corps the largest sum that had ever been appropriated up to that time for aviation in the Army, the sum of $500,000. But with the coming of the money which became available when the President signed the Army appropriation bill carrying $13,281,666 for Army aeronautics on August 28, 1916, lack of encouragement to manufacturers ceased.

General Scriven, nevertheless, found himself compelled to state in his annual report:

"In spite of the success which has been obtained in organizing and equipping this first squadron (in Mexico), although, indeed, much time and effort has been required to do so, it appears that even up to the present time the state of the art of airplane construction in this country is not satisfactory and it is still impossible to obtain suitable material in large amounts on short notice."

The cause for this statement is easily found in past governmental neglect of the aeronautical industry.

The Government must, and happily it now does, realize that the industry has been neglected shamefully hitherto. The manufacturers are beginning to realize that a new state of affairs prevails. The Government wants to encourage all who are capable of building machines. The manufacturers who coolly, quickly and conservatively go to work to put themselves in a position to turn out "nothing but the best" will receive orders.

The Navy is asking for an appropriation of $5,133,000. It would not appear that such a sum would be sufficient to supply anything like a complete aeronautical equipment for the United States Navy. However, such a sum judiciously expended can do much to build up the naval aeronautical arm.

It is essential for the proper defense of the country, as well as for the healthy advancement of the aeronautical industry, that these requests for congressional appropriations be given united support.

High Ranking Head for Naval Aeronautics

It is pleasant to hear the news that the Secretary of the Navy is contemplating the appointment of a high ranking officer to take charge of the various branches of the naval air service in order to co-ordinate them. At the present time the decentralization of the naval air service is hampering the efforts of the junior officers who have to secure authority for their every action from superiors in several different bureaus. Such decentralization must inevitably lead to delays, inefficiency and useless red tape.

A department of naval aeronautics is an immediate necessity. Its head must be a high-ranking officer who will be in constant touch with the Secretary of the Navy and whose reports will focus the attention of the public on the needs of the naval air service.

The prospects seem bright for the institution of such a bureau. When the Army air service becomes independent of its connection with the Signal Corps, and when the new Bureau of Naval Aeronautics comes to assume its proper proportions, it will be worth while to consider the advisability of a department of aeronautics separate and apart from both the War and Navy Departments.

The Army work in connection with coast artillery necessitates the training of a large number of Army officers and men in the flying and care of seaplanes, and the spotting and signalling of hits and misses at sea.

Many Navy fliers believe that they would be better fitted for aerial combats over water and military flying over water of all sorts if they were given an opportunity to execute the sharp banks, side slips, stalls and loops which are far safer in land machines than in seaplanes.

For training work the Navy and War Departments could obviously work together to advantage. In the ordering of machines, both airplanes and aerostatic equipment, the War and Navy Departments are cooperating at the present time. But this cooperation is unofficial. It is possible that official cooperation through an organization which provided for a single chief to all American air services might be advantageous. Such a step seems to be for the future. The pressing need today is for a centralized organization within the Navy Department itself. It is a great pleasure to learn that such an organization may exist in the near future.

Possible Improvements in Carrying Capacity and Speed of Rigid Airships

By C. Dornier, Count von Zeppelin's Engineer

*Abstract by W. P. Beehler**

FUNDAMENTAL EQUATIONS OF THE DIRIGIBLE

Let V equal the available gas volume of the airship in cubic meters, s the difference in specific weights between gas and air per cubic meter, then the following expression is obtained for the buoyancy of the ship, H:

$$H = V\,s \text{ in kilograms.}$$

The net weight Le (empty weight) of the ship comprises the following weights: Weight of the frame, outer hull, steering apparatus, gas cells, balancing planes, pontoons, structures, etc. The weight G_m of the machinery installation necessary for the propulsion of the ship comprises the weight of the motors and accessories, the tanks and pipes, the shafting and air propellers. If k_m is the weight of the machinery installation per horsepower in kilograms, then we obtain the following expression for the weight of the installation necessary to yield Ne horse-power:

$$G_m = k_m\ Ne \text{ in kilograms.} \qquad (1)$$

The amount of fuel oil necessary to drive the motor, per horse-power hour (k_b) may be taken as constant, and we obtain the following expression for the weight of fuel necessary to a flight of t hours:

$$B = k_b\ Ne\ t \text{ in kilograms.} \qquad (2)$$

If we substract from the lifting force the net weight of the ship, the weight of the machinery installation and the weight of the necessary fuel for the required time of flight, the remainder will equal the available carrying capacity which can be utilized for passengers, crew, munitions, etc. The relation for the available carrying capacity:

$$Nu = H - Le - Ne\ (k_m + k_b\ t) \qquad (3)$$

is then obtained.

If the resistance of the ship at v meters per second is equal to W kilograms, then the relation giving the necessary power for the development of such speed, is

$$Ne = \frac{W\,v}{n_o \times 75} \text{ in horse-power}$$

where the overall efficiency of the machinery installation is n_o.

The resistance offered by a ship in maintaining a speed of v meters per second is given by the equation

$$W = C\,v^2 \qquad (4)$$

where C is a coefficient independent of the speed.

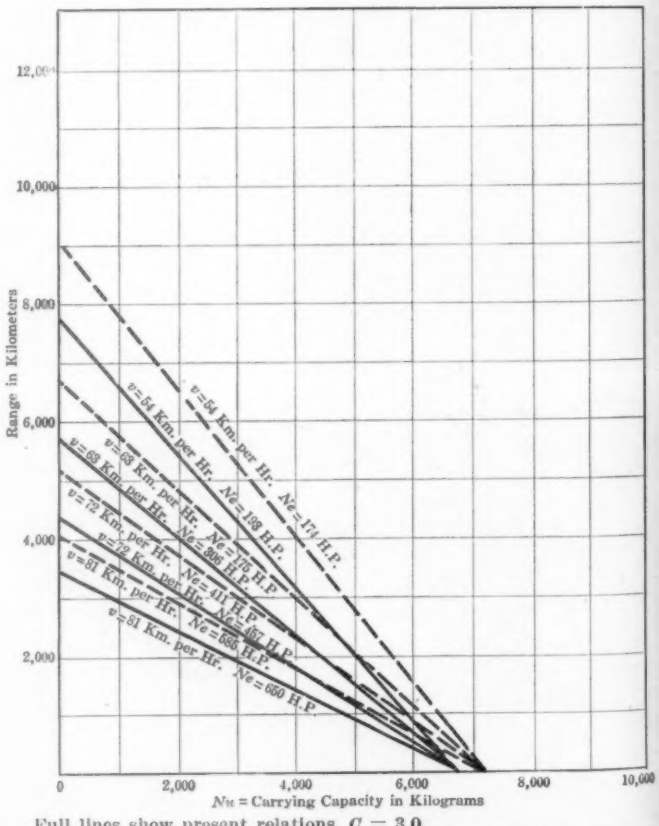
We obtain therefore:

$$Ne = \frac{C\,v^3}{n_o \times 75} \qquad (5)$$

By putting this value of Ne in the equation (3) we obtain for the available capacity:

$$Nu = H - Le - \frac{C\,v^3\,(k_m + k_b \cdot t)}{n_o \times 75} \qquad (6)$$

On account of the far-reaching value of this equation this may be termed the fundamental equation for dirigibles.



Full lines show present relations, $C = 3.0$.
Dotted lines show relations when a C is 10 per cent smaller. $C = 2.7$.
Weight of crew = 1000 kilograms, deducted.

FIG. 1. INFLUENCE OF THE REDUCTION OF THE SHIP-RESISTANCE COEFFICIENT ON A SHIP OF THE SACHSEN TYPE.

* From an article in the Annual of the Society of Naval Architects (Berlin).

POSSIBILITY OF INCREASING CARRYING CAPACITY, WITH CONSTANT VOLUME BY IMPROVING RESISTANCE COEFFICIENTS

Next must be considered the possibility of an increase in the carrying capacity of rigid airships on the assumption that an increase in the volumetric contents, or gas space, is not possible. The lifting force can only be increased, with a constant volume, by making use of a lighter gas. In the most favorable case (using a vacuum), an increase of about 7 per cent could be obtained. Practically, an increase in the carrying capacity cannot be obtained in this direction. The net weight of the ship cannot be appreciably decreased. There remains only the possibility of increasing the carrying capacity of the ship without an increase in volume, by a reduction in value of the resistance coefficient. This can be brought about by a better form for the dirigible.

Fig. 1 shows what may be obtained by a reduction of about 10 per cent of the coefficient of resistance, on a ship having about the same overall dimensions as the *Sachsen*. The available carrying capacities are taken as abscissae, and the length of voyage in kilometers is the corresponding ordinate. The broken line indicates the relations obtaining when the coefficient of resistance is reduced from 3 to 2.7. From the diagram we obtain the following improved capacities for a voyage of 4,000 kilometers:

At 54 kilometers per hour, 4,100 kilograms, against 3,400 kilograms with the Sachsen class;
At 63 kilometers per hour, 3,000 kilograms, againt 2,200 kilograms with the Sachsen class;
At 72 kilometers per hour, 1,700 kilograms, against 770 kilograms with the Sachsen class;
At 81 kilometers per hour, 200 kilograms, against 0 kilograms with the Sachsen class.

The above diagram also shows a considerable reduction in the power requirements.

POSSIBILITY OF INCREASED RANGE, WITH CONSTANT VOLUME BY IMPROVEMENTS IN POWER INSTALLATION

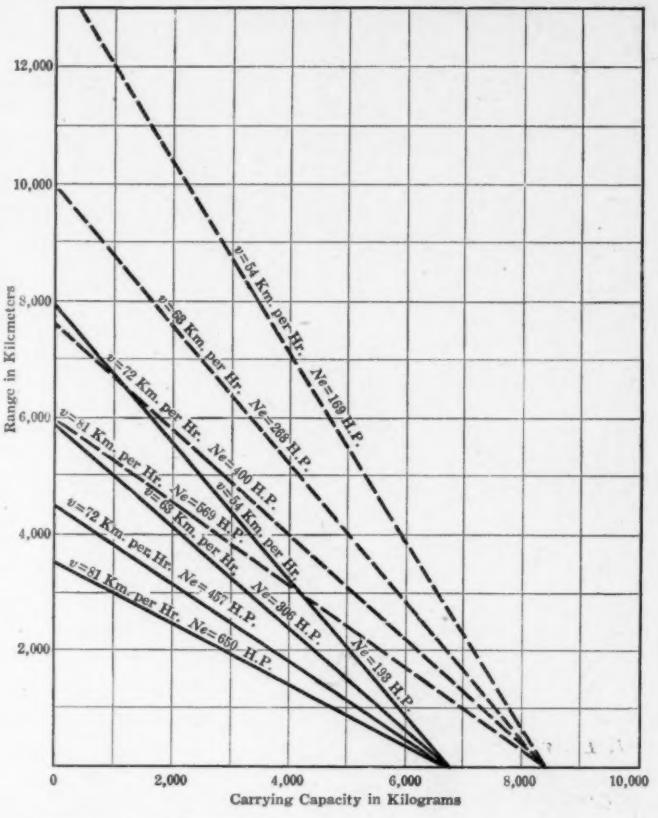
The overall efficiency of the air propeller installation, which at present lies between 0.65 and 0.70 on account of the influence of the propellers on each other, may still be slightly improved. Fig. 2 shows, however, for the ship used as a basis for Fig. 1, also, the improvement in range when n_o equals 0.8 instead of 0.7; k_m equals 4 instead of 6 kilograms per horsepower, and k_b equals 0.2 in place of 0.24 kilograms per horsepower hour. The increase in range obtained thereby, as shown by the diagram, is extraordinary. We take the value from the 3,000 kilogram carrying capacity ordinate:

At 54 kilometers per hour, 8,750 kilometers, against 4,500 kilometers with the Sachsen class;
At 63 kilometers per hour, 6,450 kilometers, against 3,300 kilometers with the Sachsen class;
At 72 kilometers per hour, 4,850 kilometers, against 2,500 kilometers with the Sachsen class;
At 81 kilometers per hour, 3,800 kilometers, against 2,000 kilometers with the Sachsen class.

These figures speak for themselves, and may soon be attained.

IMPROVEMENT IN CARRYING CAPACITY AND RANGE WITH INCREASE IN SIZE

The considerations will be limited to a fleet of similar ships having the ratio of diameter to length equal to 0.1, in accordance with current practice. The outer form of the ship will also be similar to the construction in vogue at present.



Full lines show Sachsen type.
Dotted lines show possibility of improved type.

FIG. 2. INFLUENCE OF AN IMPROVEMENT *of* k_m, k_b AND n ON SHIPS OF THE SACHSEN TYPE.

From experience obtained with ships of from 11 to 16.6 meters in diameter, as well as the exact weight measurements obtained on ships of from 22 to 25 meters diameter, certain fundamental relations can be established which can be used for the entire range of ships of diameters from 8 to 30 meters, and a corresponding length of 80 to 300 meters. The length of the ship will always be taken as 10 times the diameter, so that when the diameter is given the other overall dimensions of the ship are definitely established.

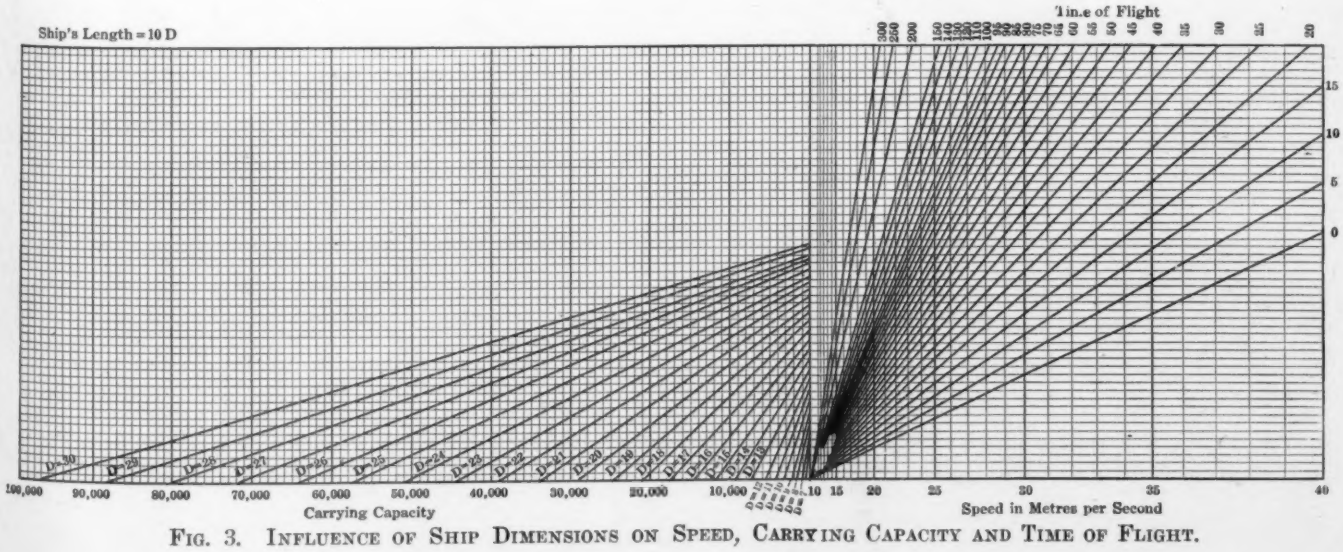


FIG. 3. INFLUENCE OF SHIP DIMENSIONS ON SPEED, CARRYING CAPACITY AND TIME OF FLIGHT.

Numerical examples taken from the curves of Fig. 3 will show clearly the influence of an increase in the overall dimensions on the power of the ship:

1. *Given,* the length of voyage of time of flight and the speed; *desired,* the available capacities obtainable for a given ship. As numerical examples take a distance 7200 kilometers; mean speed, 72 kilometers per hour; the time of flight is, therefore, 100 hours and the speed is, therefore, 20 meters per second. We then look for the intersection of the line v equals 20 and t equals 100, of the various sized ships. We read for example:

D equals	18	20	22	25	30 meters.
Nu equals	600	3400	7300	25200	33300 kilograms.

The increase in the diameter from 18 to 30 meters, therefore, raises the available carrying capacity 55 times.

2. *Given* the available capacity and speed; *desired* the time of flight and the distance travelled for ships of various sizes. As a numerical example: Capacity 15,000 kilograms, speed 25 meters per second equals 90 kilometers per hour.

We find the point of intersection of the various ship lines with the ordinate at the point where the capacity is 15,000 kilograms. The diagram shows us that 15,000 kilograms capacity can only be obtained by ships having a greater diameter than 16 meters. We obtain the following, for example, from the diagram for a speed of 25 meters per second.

D equals	20	22	25	30 meters.
t equals	10	23	39.5	57.5 hours.
s equals	900	2070	3660	5180 kilometers.

But lifting capacity and the distance traveled are not the only factors increased with increased volume. The diagram in Fig. 3 shows plainly that for equal capacity and time of flight the larger ship will travel faster than the smaller.

IMPROVEMENT WITH COMBINATION OF INCREASED VOLUME AND IMPROVED INSTALLATION FACTORS

A further improvement is possible, when in addition to an increase in volume, an improvement is made in the factors, H, Le, n_o, C, k_m and k_b. Every point between the inclined lines on the right hand side of the diagram, Fig. 3, and the y-axis determines a definite distance traveled, since the distance traveled equals the speed multiplied by the time of flight. If we draw a parallel to the x-axis from any desired point on the right hand side of the diagram to intersect a definite ship line, inclined lines on the left hand side of the diagram, then the abscissa corresponding to this point of intersection will give the corresponding capacity provided the constants are assumed as follows:

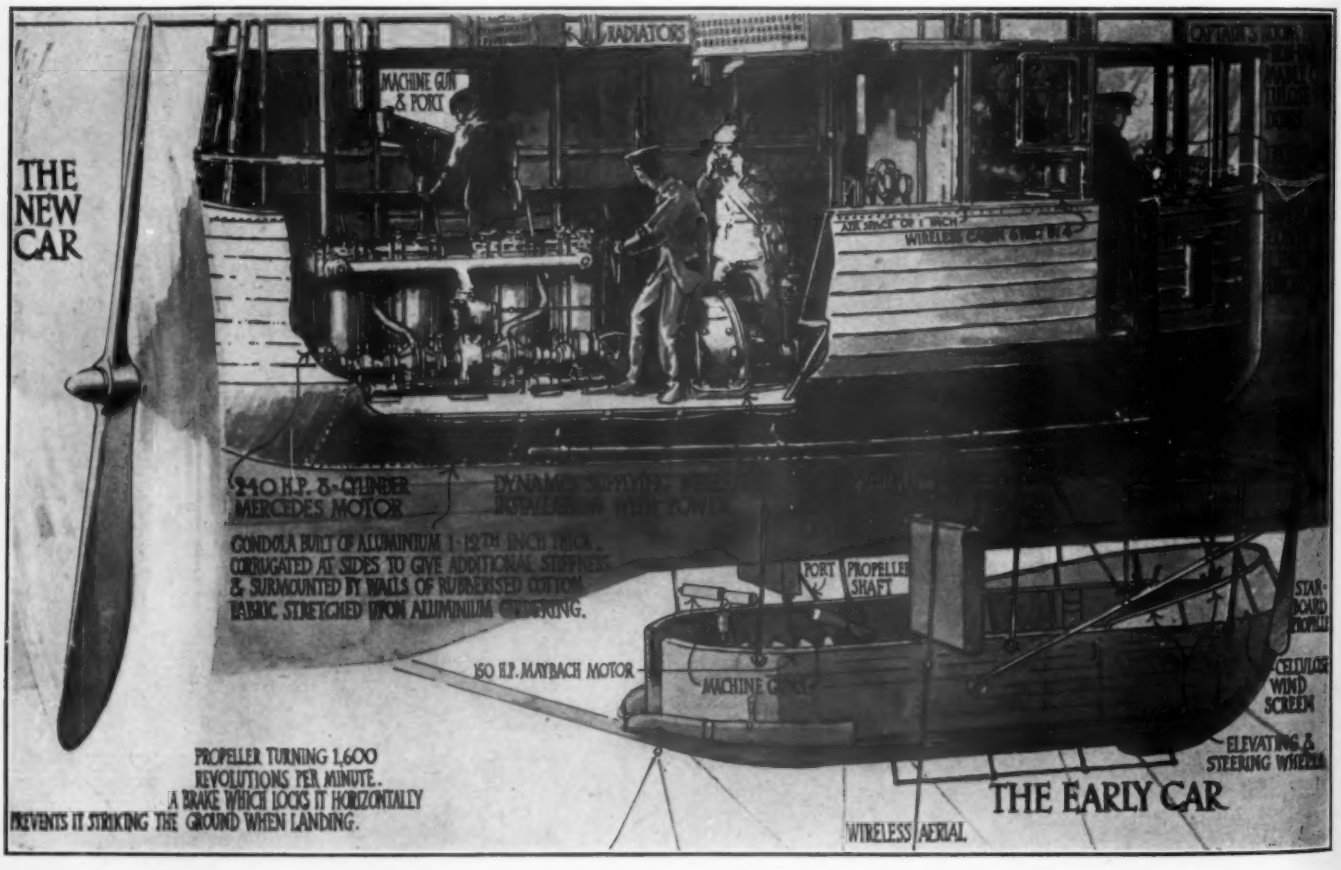
$$k_m = 6,\ k_b = .24 \text{ and } n_o = 1.$$

The intersection of these various ship lines with the x-axis corresponds to the values of $H - Le$. If H or Le is improved (if H is increased or Le decreased) then these points of intersection will fall further to the left, which means that one would obtain a greater carrying capacity for a definite size of ship. The inclination of these ship lines to the x-axis is determined by the value of the coefficient of resistance, C, and the value of n_o assumed equal to 0.7. If these values are improved then the lines for the ships of various diameters would cut the x-axis at a greater angle, or would tend to be more nearly vertical, and, as is easily seen, this would mean an appreciable increase in speed and therefore in the distance traveled for a ship having the same carrying capacity.

An improvement in the values of k_m and k_b has the result, that the lines on the right hand side of the diagram corresponding to definite machinery weights and fuel consumption would approach closer to the x-axis, or in other words, would be swung through an angle to the right, so that with equal speeds and time of flight, there would be an increase in the carrying capacity.

The amount of the influence on these factors is determined, since with an increase in the overall efficiency of n_o from 0.70 to 0.75, at a speed of 30 meters per second and for a 25-hour flight, the capacities for ships of 25, 26 and 27 meters diameter will be increased as follows:

D equals	25	26	27 meters.
Nu at n_o equal to 0.7	1200	2200	4000 kilograms.
Nu at n_o equal to 0.75	4900	6300	8600 kilograms.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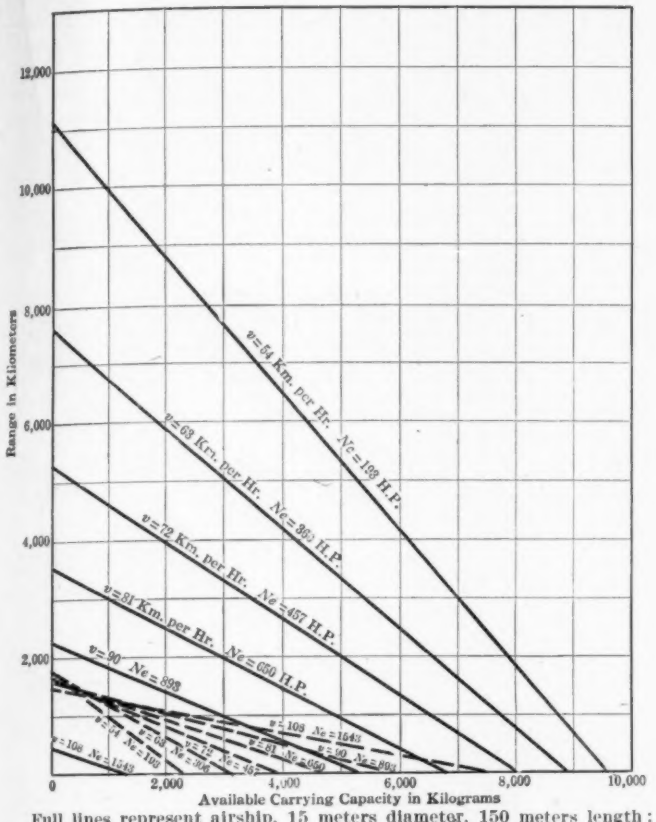
150 H.P. MAYBACH MOTOR
MACHINE GUN
CELLULOID WIND SCREEN
ELEVATING & STEERING WHEEL
PROPELLER TURNING 1,600 REVOLUTIONS PER MINUTE. A BRAKE WHICH LOCKS IT HORIZONTALLY PREVENTS IT STRIKING THE GROUND WHEN LANDING.
THE EARLY CAR
WIRELESS AERIAL

WAR DEVELOPMENT IN ZEPPELIN GONDOLAS.

The top car is a commander's gondola in one of the new Zeppelins shown in flight. The lower picture illustrates the sort of car used at the beginning of the war. The length of the new gondola is 45 feet as compared with 28 feet for the earlier one, and many other radical alterations are shown. These drawings were made for the Graphic (London) by S. W. Clatworthy.



Full lines represent airship. 15 meters diameter, 150 meters length; $n = .7$; $k = 6$; $k = 24$; C 3.0.
Dotted lines represent airplane; $n = .7$; $k^n = 2.5$; $kb = 3 \times 1.2$; $k = 0.13$.
With airships 1,000 kilograms is deducted for weight of crew.

FIG. 4. COMPARISON BETWEEN AIRSHIPS AND AIRPLANES.

In practice, increase in volume, perfection of the machinery installation and reduction of the resistance coefficient, go hand in hand, the only drawback being that with increase in size, the cost of construction and maintenance increase very rapidly. As a result of the above considerations, it can be safely said the airship is not at the end but at the beginning of its development.

COMPARISON BETWEEN AIRSHIPS AND AIRPLANES

In order to make a direct comparison between motor airships and airplanes, the diagram in Fig. 4 is given. The airplane curves have been derived from data obtained from the German Aeronautical Experiment Station at Aldershof. This shows the capacity of a ship of the Sachsen type fitted out with machinery installations of various powers, and at different speeds, compared with airplanes working with the same powered engines and at the same speed.

From the diagram, it is seen that, so long as it is simply a question of long voyages at a medium speed, the motor airship has the advantage over airplanes. If on the other hand it is a question of short distances at very high speed, then the airplane is much superior to the motor airship.

The lines for airships and airplanes cross at as high a speed as 90 kilometers per hour. At 108 kilometers per hour the motor airship cannot keep pace with the corresponding airplane of equal power. The values given in the diagram are of course not absolute, but are useful for purposes of comparison.

Some conclusions of Count von Zeppelin on Dornier's paper also show that the airplane is more dependent than the airship on the condition of the machinery installation. For relatively short trips up to about 1,000 kilometers, when it is a question of making the journey in the shortest possible time, they are admitted to surpass the airships on account of their much greater speed, but if it is a question of a continuous flight of over 3,000 kilometers where no landing base may be erected, such as across the Atlantic Ocean, the airship is indubitably superior.

Count von Zeppelin also suggests that the discovery of a noncombustible gas for filling the cells, even though less light, is not impossible, and that a point has already come where the gradual increase in the size of airships may enable them to be operated when filled with a heavier noncombustible gas

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Contracts Let by Army for $2,007,000 Worth of Seaplanes

The Aviation Section of the Signal Corps, U. S. A., awarded on December 6 preliminary orders for 96 twin-motored seaplanes to cost $2,007,000. Further orders under this proposal are under consideration awaiting demonstration of types. The machines will be used for coast defenses of the United States, the Philippines, Hawaii and the Panama Canal. Thirty-two machines were awarded to the Standard Aero Corporation of Plainfield, N. J., thirty-two to the Burgess Company of Marblehead, Mass., sixteen to the Curtiss Aeroplane & Motor Corporation of Buffalo, N. Y., and sixteen to the Aeromarine Sales and Engineering Company of New York. The motors for these big machines will be furnished by the Hall-Scott Motor Car Company of San Francisco, the Curtiss Aeroplane and Motor Corporation of Buffalo, and the B. F. Sturtevant Company of Boston.

Specifications and proposals are being prepared for fast pursuit machines, which will be ready in a short time.

With these orders the Aviation Section now has under order, or delivered, more than 350 machines. Of the appropriation for aviation of $13,281,666 allowed in August, about $7,000,000 has been obligated for airplanes, hangars, motor trucks, motor repair shops, motorcycles and aeronautical accessories of all kinds. Orders have also been placed for aerostatic equipment, including kite balloons for field artillery, fire control, etc.

PLANS COMPLETED FOR SEVEN STATIONS

Plans are about completed for the establishment of seven army aviation stations and schools. Already stations and schools have been instituted as follows: At San Diego, Cal.; Chicago, Ill.; Mineola, N. Y.; Newport News, Va.; Miami, Fla.; San Antonio, Texas; Columbus, N. M. Stations at Memphis, Tenn., and Philadelphia, Pa., will probably be established before long. At each of the stations a corps of instructors will be maintained, at which classes of National Guard officers and reserve aviators will be conducted. With this system of schools and stations the entire country will be covered, and it is believed that an efficient corps of active and reserve aviators can be developed.

One of the latest features inaugurated by the Aviation Section of the Signal Corps is a course of instruction for field officers, which will be conducted at San Diego. In this course the tactical use of airplanes will be taught. The following officers have been detailed to take the course: Col. William L. Kenly, Field Art., Lieut.-Col. Henry Bishop, Field Art., Major John D. Bennet, Inf., Major W. A. Burnside, 29th Inf.

A site is being selected for an experimental station and proving ground which it is proposed to name "Langley Field," as a permanent monument to the fundamental pioneer work in aeronautics of Samuel Pierpont Langley, who did his work under governmental grants.

The schools of flying instruction conducted by private concerns are now training aviators for the Army. As rapidly as candidates for the Aerial Reserve Corps can be examined they are being sent to the aviation schools for training.

ARMY BUYING "SEA SLEDS"

For use in connection with the twin-motored hydro-airplanes, "sea sleds," with a speed of 42 miles per hour are in use and others are ordered. These fast power boats are used to go to the assistance of any of the hydro-airplanes when they are in difficulties.

$15,600,000 ASKED FOR 1917-18

The Treasury Book of Estimates, as submitted at the opening of Congress, contains the following statement:

	Recommended for year ending June 30, 1918.	Appropriated for 1917.
Signal service of the Army.....	$16,600,000	$14,281,766

(Not more than $15,600,000 of the Signal Service appropriation shall be devoted to aviation needs, $3,000,000 of this sum being available for sites and buildings for aviation schools in Central and Eastern Military Departments.)

Last year $13,281,666 was appropriated for military aeronautics.

A Time Controlled Aerial Torpedo

By Willard G. Moore

The aerial bomb has advanced through its various stages of development from the most primitive methods to the more finished product and certainly more effective projectile now used by warring Europe. The Ehrhardt Munition Co. of Germany has attained the distinction of having produced what is perhaps the most effective weapon of this type. This is followed in close succession by a self-propelling torpedo supposed to be an output of the Krupp Works, which travels parallel to the surface of the earth under its own power when released from a skid beneath the biplane to any given calculated range. It then dips of its own volition to its target

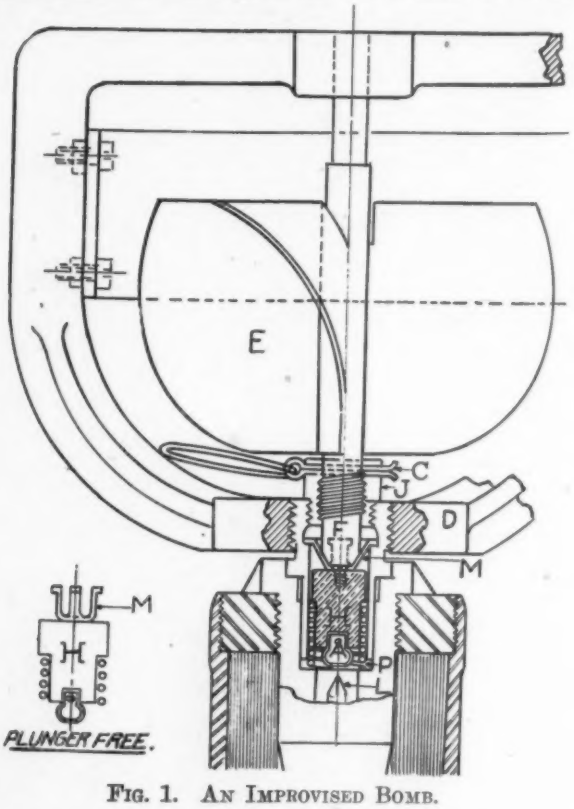


FIG. 1. AN IMPROVISED BOMB.

and explodes upon striking it. To this type, however, too much credence should not be given although detailed reports have reached this country.

We will, however, consider types of bombs that have rapidly reached a satisfactory experimental stage and have actually given satisfaction in practical tests. One very successful type is the emergency torpedo, which involves the conversion of different types of high explosive projectiles into aerial torpedoes at a moment's notice and can be assembled very expeditiously in the field, being suitable for use as a drop bomb. It also provides an economic use for shells, that are defective due to errors in manufacture.

A DROP BOMB

The common faults of shell manufacture appear in defective threads or too thin bases, but most common of all is failure to undergo the hydraulic pressure test of 20,000 pounds per square inch through the existence of a porous overcracked base. While a projectile of this nature is perfectly good for a drop bomb the weak base would not withstand the powder pressure in the gun. The construction of this improvised bomb is shown in Fig. 1.

The shell to which it is attached happens to be a British 4.5 commonly used as a field gun projectile. The part containing the detonating fuse has been removed. The steel closing disc *A* is screwed home in its seat into which in turn is connected a base detonating fuse. To this is attached a simply constructed 4-vane propeller, *E*, which is firmly fastened to an upright shaft, *F*. This is all self-contained in a light frame, *D*, of aluminum alloy casting.

When upon removal of the safety pin, *C*, the bomb is dropped, the motion of the air against the propeller blades, *E*, gives the shaft a rotary motor sufficient to unscrew it from the bushing, *J*, and as the end, *F*, is raised free of the stirrup cup spring, *M*, the arms of this spring recoil back to the center and in turn free the plunger, *H*, to which the stirrup cup is attached.

The primer, *A*, of this plunger is now only prevented from striking the firing pin, *L*, by the restraining power of the armed resistance spring, *P*. The strength of this pin is not sufficient to check the downward plunge of the percussion primer when the shell strikes its target, hence the explosion results at the moment of impact. The shell is usually loaded with "T. N. T.," or tri-nitro-toluol, a redistillation product from crude benzol (toluene) $C_7 H_8$ which when treated with nitric and sulphuric acid and subjected to heat for 48 hours yields tri-nitro-toluol.

AN AERIAL TORPEDO

The torpedo shown in Fig. 2 is not a converted type but a special design with all the refinements of manufacture embodying the elements of safety in handling, some zone of demolition, or destructive power and a time control. The difficulty that previously confronted manufacturers of aerial bombs was to provide a time control in order to explode them by some other method than by impact.

It is well known that there is not a single artillery projectile fired out of a gun that has not some feature in its fuse attachment with a time control in direct relation to its time of flight, and the absence of this in the aerial bomb has been only too apparent in the European War, where in reports that have reached us a large percentage have dropped with precision to their targets only to bury themselves in the earth to such a distance as to render their explosive force useless.

All too late for shop remedy this has forced itself upon the attention of field commanders who, we are told, as a last resource have improvised a sleeve or jacket that is placed over the exterior of the projectile to be dropped. The prongs of this sleeve projecting out radially from the axis are, in a measure, to retard the burying propensity of the bombs. This expedient has produced some good results and though praiseworthy as a field method must offer a great resistance to the downward flight of the torpedo, with a tendency to make it tumble.

It is an established fact that while there have been instances of premature explosions in the bore of the gun caused by defective time fuses they are extremely rare.

This combination time fuse, as the reader already probably knows, starts burning by the ignition of the concussion primer induced by the pressure exerted upon the base of the projectile at the initial impulse of discharge in the bore of the gun.

Now, as we have none of these aids provided in the case of the drop bomb there was quite a problem to solve in order to provide a safe percussion start for the burning of the time rings. This has been overcome in the torpedo shown in detail in Fig. 2. We say in detail, although the head is not sectionalized on account of the torpedo being of private design with patent rights pending on

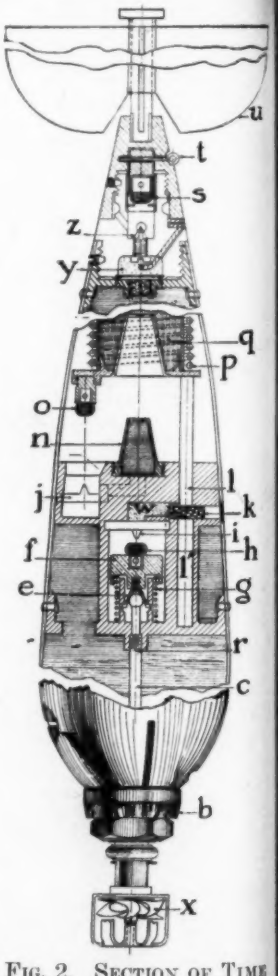


FIG. 2. SECTION OF TIME CONTROLLED AERIAL TORPEDO.

these parts. There is enough of its construction shown, however, to give a comprehensive idea of how it works. It is one of the newest types and embodies many of the features that have proved to be of the highest value in the war zone. It has the advantage over many others in the fact that it can be exploded at any given calculated range in mid-air or on the target in cases where the construction of the target is of too yielding or soft a material to offer sufficient resistance; so as to make a straight percussion type at the best uncertain. The reference is made to the soft bags of some of the dirigible air craft.

FIG. 3. COMPLETED TORPEDOES AT THE FRANKFORD ARSENAL.

In fact this is claimed to be the only torpedo in the United States at the present time that has a complete detonating system controlled by a combination time element with the booster charge entirely removed from the vicinity of the detonator until the moment the explosion is actually desired.

The aviator calculates the distance he is from his target and sets the nose of the bomb opposite the graduation, *b*, that corresponds to this distance. The momentum of the first 50 feet fires the auxiliary primer, *n*. This is accomplished by the propeller, *x*, fastened to the shaft, *c*, which by a rotary motion releases itself by means of the screw thread, *r*, and drops its spherical end free of the stirrup cup-spring, *e*. The spring then recoils to its former shape and allows the plunger, *f*, forced by the spring, *g*, to go up with its primer, *h*, upon the firing pin, *i*.

The flame is carried through the vent, *w*, to the cylinder of plaited rope powder composition, *k*, which burns away allowing the plunger stem, *l*, to imbed itself in the cavity forward, l^1, being forced down by the spring, *p*. Then for the first time the picric acid booster charge, *q*, is allowed to incase itself around the detonator, *n*. The element of danger in other construction is that the detonator is nearly always in the midst of the main explosive.

The booster charge is forced downward in its position around the detonator by the spring, *p*. In this movement the primer, *o*, is forced upon the firing pin, *j*, whereby the flame is carried to the detonator via the long or shortened time trains as the prior setting on the nose of the torpedo has determined. The main explosive is now detonated. Of course, this torpedo has all the advantages of the straight percussion features common to all torpedoes, that of exploding upon impact, in addition to its time control element.

The impact detonator is located in the rear of the stem. The firing pin is shown at *z*; *s* is the primer; *t* the safety wire and *y*, the powder communicating to the detonator. The rear steering vane is indicated at *u*.

The torpedo shown in Fig. 3 is the Barlow invention and for certain reasons little can be said or described about its interior mechanism other than it has many novel devices in its construction. The inventor has profited by his experiences on the staff of General Villa when he exploded his torpedo 7 feet above his target instead of allowing it to bury itself before exploding.

This torpedo was tried out in practical tests recently at the Mineola airdrome, and seven were dropped from an airplane at varying altitudes up to 7,000 feet. The high speed at which the biplane was going when the torpedoes were dropped disillusioned some of the official spectators among whom the idea was prevalent that the bomb would drop perpendicularly, or in other words have a flat trajectory.

It was clearly brought forth that when the bombs were dropped at lower altitudes where their movement was slow enough to be noted, a distinct parabolic curve was described through a resultant high arc trajectory that marked the descent of the first bombs dropped. This of course was due to the momentum of the biplane. During the tests from the higher altitudes the torpedo could not be seen, the attained velocity being in some cases as great as 700 feet per second.

The approach of these bombs were preceded by a shrill whistling sound caused probably by the propeller blades. Next a terrific explosion occurred, the air being driven against the faces of the observers who were stationed fully one half mile distant. These bombs weigh approximately one hundred pounds.

Lieut. Herbert Dargue Reports on Night Flying

Searchlights mounted on a movable base in proximity to the pilot, should be placed on all airplanes employed in night flying, according to Lieut. Herbert Dargue, instructor in flying at the North Island military aerodrome, according to the San Diego, Cal., *Union*. Probably no military aviator in America has delved deeper into the problems of night flying than Lieutenant Dargue, and his report to the war department on this phase of military aeronautics will be read with interest by followers of aviation.

Lieutenant Dargue suggests that airplane searchlights derive their current from a small generator fastened to the wing and driven by an air screw propeller. He does not believe that the efficiency of the airplane motor should be impaired for propelling purposes by utilizing a part of its power to generate current for lighting.

Military aviators engaged in night reconnaissance or bomb dropping flights would be enabled, by the use of searchlights, to obtain a good idea of the topography of the terrain where it was proposed to make a landing and would unquestionably save much money in breakage when extensive night flying is begun at the North Island school.

ANTI-AIRCRAFT GUNS EFFECTIVE AT 16,000 FEET

Information received from the British royal flying corps by American military aviators discloses the fact that the airplane has not kept pace with the development of the anti-aircraft gun, and that day bombing expeditions are now a thing of the past. Aviators have been winged at altitudes of more than 16,000 feet by anti-aircraft shellfire. Practically all the flying over the enemy's lines is now accomplished at night at altitudes varying from 7000 to 10,000 feet until the objective point is reached, when the airplanes swoop down to less than 1000 feet, the gunners being unable to locate their exact position unless the plane gets in a direct line with the moon, when the wings stand out in bold relief. The moon, however, is a great help to night fliers in the event that a forced landing is necessary in territory with which the pilot is unfamiliar.

In his report to the war department Lieutenant Dargue suggested that all instruments necessary for night flying, including inclinometer, altimeter, tachometer, gas and oil gauges should have luminous dials. A pocket flashlight is essential also in case of minor repairs to motor or landing gear.

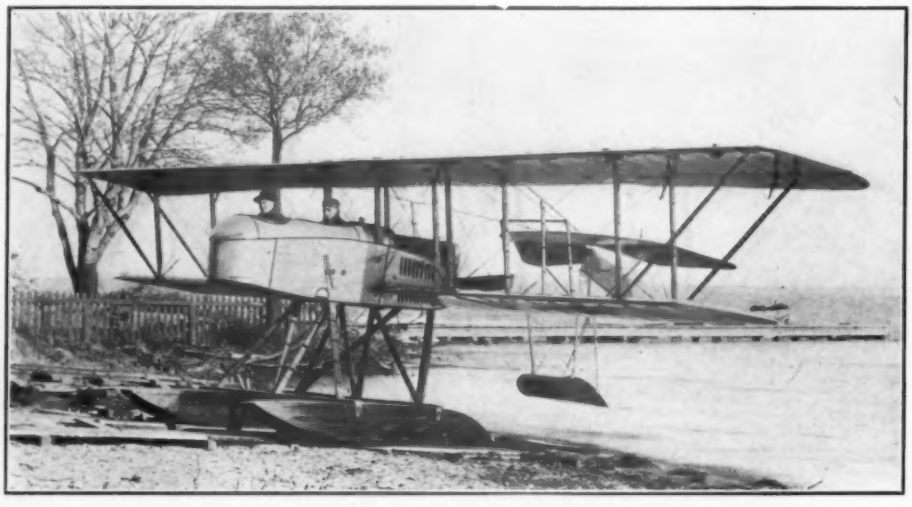
For practice flights at night between San Diego and Los Angeles, small illuminated arrows should be located at various points, the arrows being adjustable so as to indicate the direction of the wind. Lighthouses, with a group or single beam of distinctive lights, also should be placed, said Lieutenant Dargue, to mark the location of safe landing places.

The Verville Pusher Type Seaplane and Gun-Carrying Machine

Limited observation and firing range due to the necessary position of the propeller mount is one of the disadvantages of the tractor type of airplane, while the flying boat is handicapped by a high net weight that limits the useful load.

The pusher seaplane presents advantages for bomb dropping, observation, reconnaissance, scouting and for fighting purposes over other aircraft. In a machine of the type of the Verville pusher seaplane, a gun mounted in the body can maintain an effective and destructive fire through an arc of 230 degrees, while the gunner is not bothered by the propeller as in a plane of the tractor type.

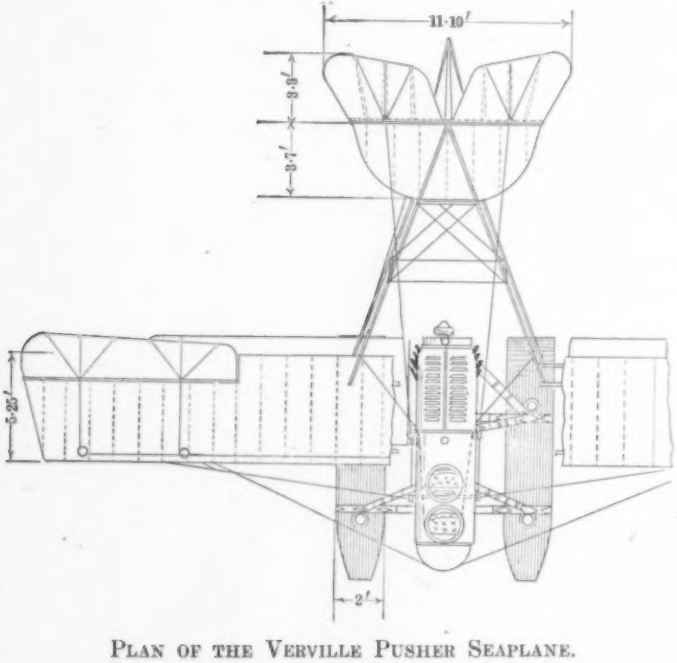
In this airplane the quality of seaworthiness is secured by the twin float system and the location of the body. The lateral alighting stability is obtained by the relative position of center of float buoyancy to the center of gravity of the machine. The ratio of float buoyancy is to the full load as 2¼ is to 1. The following interesting information regarding the construction of the Verville pusher seaplane has been furnished by its manufacturer, the General Aeroplane Company, Detroit, Mich.:



THE VERVILLE PUSHER TYPE SEAPLANE.

Descriptive Outline.—The pilot and passenger are accommodated in tandem seats in a roomy well-protected cockpit, situated so as to afford the maximum range of vision for each.

Materials.—Silver spruce, white ash, oak, linen proofing



PLAN OF THE VERVILLE PUSHER SEAPLANE.

dope, metal parts, etc., are selected from the finest stocks obtainable with high elastic limit and tensile strength. Economizing has been ignored both in the cost of raw material and in workmanship.

Motor Group.—The machine is equipped with a 100 horsepower Curtiss OXX-2 motor.

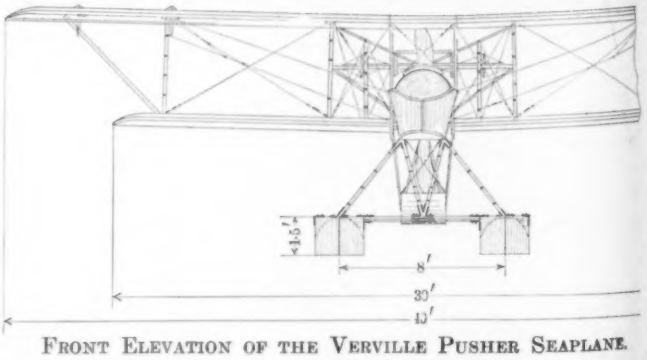
Propeller.—A two-blade flexing copper tipped, direct motor driven Paragon propeller is employed. It is 8 feet in diameter and has a 6 foot pitch.

Radiator.—The radiator which has a 24 gage polished brass casing is of the cellular type with an efficient core and is made of 34 gage copper. Its water capacity is three gallons, and the water circulation is obtained by a direct motor driven centrifugal pump.

Fuel Tanks.—The service tank which has a capacity of 35 gallons, is made of 22 gage terne coated steel and is equipped with baffle plates, capacity gage, pressure gage, auxiliary pressure pump, 5-16 inch carburetor outlet and a 2¼ in. air-tight brass filler cap. A three gallon auxiliary gravity tank is also supplied.

Wings.—A highly efficient section permits the use of liberal sized I-beam section spruce wing spars. The ribs are of I-beam section spruce with web and cap strips. The trailing edge is made of Shelby steel tubing. Strong internal drift wire bracing is accomplished with Roebling aviator wire. The wings are covered with unbleached Irish linen as specified by the British government. It has a strength in weft of 91 pounds per inch width and in warp of 103 pounds, and is doped with nine coats of Emaillite and surfaced with three coats of Valspar to reduce friction to a minimum and to render the wing impervious to the action of air and water. The linen cloth is stitched with No. 8 Irish linen thread at intervals of 4 inches along ribs, thus obviating the use of nails which have a tendency to split the members. This method which adds to the staying qualities of the cloth to the wing structure with ease and without injury, also renders the recovering of the wing framework a simple operation. The linen used is 35 inches wide, and is sewed with the English welt seam.

The wing struts are made of Virginia silver spruce, well seasoned, and coated with three rubbed coats of Valspar. The strut ends are copper tipped, and the struts are bound at intervals of 12 inches with three wraps of ¾ inch gray silk to relieve shattering of the wood fiber. They are built with a 2½ to 1 streamline fineness ratio and have a weight to resistance ratio of 6. The strut wing fastenings are of unusual design and obviate the disadvantages of the conventional fastenings by belts and piercing of the beam. The lower wing beams extend through a metal box at the body and are joined internally by a steel casing.

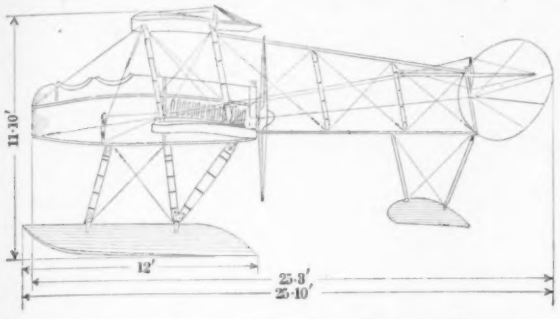


FRONT ELEVATION OF THE VERVILLE PUSHER SEAPLANE.

Ailerons.—The ailerons are hinged to the extremities of the top wing at the rear wing spar by five cold rolled steel hinges. Two sets of pylons are mounted near the aileron edge in a steel casing. The equalizing aileron control passes through an aluminum pulley box and fair leaders along the front spar of the top wing. Two and one-quarter inch Lynite pulleys having brass bushings are used throughout.

Body.—The body of the cellular nacelle type is constructed of ash and spruce, heavily wired top and bottom, and is covered and crowned with light gage aluminum or protected with light chrome steel sandwich armor to suit military requirements. The engine is covered by a hinged cowl. The cockpits are veneered with bass wood and upholstered with green leather. The seats, which are of the aluminum bucket type, are comfortably upholstered, and the seat cushions are filled with sufficient Kapok to float a 250 pound man for 24 hours. The engine bearers built of oak and spruce are fitted in the steel engine plate at the rear of the body, and careful provision is made for suitably attaching the radiator.

The laminated dashboard is made of polished mahogany, and is equipped with altitude barometer recording to 15,000



SIDE ELEVATION OF THE VERVILLE PUSHER SEAPLANE.

feet, Tycos inclinometer, Tycos speed indicator, Tycos tachometer gas line pressure gage, eight day clock, oil pressure gage, electric light gang switch, dashboard light, motor cut-out switch, hand throttle and magneto control. Four Ever-Ready cells are provided for lighting dashboard light, wing tip light, and head and tail lights. The hand pump is convenient to the pilot at the side of the body. The construction of the body is suitable for mounting a machine gun.

Floats.—The main floats of twin type, with a nine-foot tread are braced to the body by stout stream-line members and counter wired oak ribs. They are diagonally spruce planked and longitudinally planked with Honduras mahogany, the two layers being interspersed with four-ounce treated sheeting. The floats are divided into two watertight compartments by an aluminum bulkhead, and are rendered accessible by 24-inch aluminum inspection covers. The floats have the V-type entering edge which spreads to a flat surface at rear, and are internally treated with boiled oil. Their displacement factor is 2¼ to 1. The tail float of mahogany stream-line section has a displacement capacity of 350 pounds.

The chassis for land is of the wheel and skid type, the two 26 x 5-inch Goodyear wheels being sprung on a tubular Shelby steel split hinged axle at the center of the chassis and is stoutly thrust wired. The shock absorbers are made of ½-inch Goodyear cord elastic, wound around twin drums over the axle head. The wheel hub is made of manganese bronze and the wheels are dished with aluminum.

Controls.—The Deperdussin type of control is used.

Summary.—The factor of safety of 7 is employed throughout the machine which is double wired, and this factor of safety is taken on but one cable. French national turnbuckles are used throughout. All cable joints are wrapped with 24 gage soft copper wire and are sweated with solder, with all joints at least three inches long. The control cable is made of ⅛-inch extra flexible Roebling cable. A shock absorbing tail skid is furnished with land machines. The body is finished in battleship gray or to taste. All internal wing control surfaces, spars and web structures are treated with shellac. All metal parts are treated with a primer and are baked with three coats of a non-corroding enamel.

Estimated Seaplane Characteristics.—The estimated characteristics and performances of the Verville pusher seaplane are as follows:

Span	top 40 feet; bottom 34 feet.
Gap	5 feet.
Chord	5 feet.
Length over all	23 feet 6 inches.
Rudder	12 square feet.
Ailerons	40 square feet.
Elevators	18 square feet.
Stabilizer	18 square feet.
Gliding angle	1 in 7.
Angle of incidence of planes, normal	3 degrees.
Angle of incidence of planes, fast	2
Angle of incidence of planes, slow	14 degrees.
Angle of incidence of tail plane	0 degrees.
Safe range of incidence	0 to 14 degrees.
Passengers	2
Power plant	Curtiss OXX-2.
Fuel capacity	5 hours.
Speed range, fully loaded	4 hours; 45 to 78 miles per hour.
Climbing speed	2,800 feet in 10 minutes.
Weight, loaded	2,000 pounds.
Weight, unloaded	1,400 pounds.

Crating for shipment.—The sizes of the crates required for the shipment of this machine are as follows:

Wing crate: 5½ feet wide; 3 feet high; 20 feet long.
Motor crate: 3 feet wide; 3½ feet high; 5 feet long.
Body crate: 3 feet wide; 3 feet high; 10 feet long.
Float crates: 3 feet wide; 2 feet high; 13 feet long.
Strut crate: 3 feet wide; 2 feet high; 13 feet long.
Control crate: 2 feet wide; 5 feet high; 10 feet long.
Ailerons, stabilizers, rudders and elevators.

The British Aeronautical Situation

Lord Montagu of Beaulieu recently reviewed the British military situation in the air in two articles in the London *Times*. His statement has revived the question of the advisability of a single control over the British army and navy air service. Germany is said to have recently decided to have an air minister and many American military and naval authorities believe such a system should be adopted for the United States.

"There has been such a marked change for the better," says Lord Montagu, "compared with twelve months ago, on the Flanders front and elsewhere, and the output of men and materials has increased so much that, looking back to November, 1915, it is not too much to say that a year ago our present position would have seemed ideal. The superiority of the enemy in regard to certain types of airplanes was undeniable at that time. It is not so now.

"In aviation on the Western front one great change has recently come over the character of our operations. During the retreat in September, 1914, from Mons and Le Cateau, I am not exaggerating when I say that it was our aircraft that largely saved our retiring divisions from the chances of annihilation or surrender. But from then onwards until about six months ago our aircraft, though superior then as now in personnel, which was more daring, was not able to achieve anything like supremacy at the front, nor even in certain places was it the equal of the air forces of the enemy. Taken as a whole our machines were too slow, and the result was that valuable lives were often lost in the work of reconnaissance and photography, as well as in fighting and bombing expeditions.

"The air twenty miles each side of the front trenches at that time was air common to both armies, patrolled and fought in by both, and the movements and dispositions of each side were known to the other so far as air reconnaissance could report. With regard to our losses in pilots and machines at that time, however, two things should be remembered—that our pilots did much more work than the German pilots, and that our air work was done for the army and seldom failed it. There was no sensational flying and 'starring' by pilots like Immelmann. The work of our pilots was at a high level of excellence all through, and our loses were therefore bound to be heavier.

"Now, however, it is not too much to say that the enemy's air has become our air. Primarily, I would say that the improvement is due to the better quality even more than the greater quantity of our machines, and especially of our engines. As regards mere numbers, there are very many more squadrons and airplanes at the front now than there were there nine months ago. To increase or even to maintain our present strength and to make up for losess in personnel and material, better organization of training facilities and increase in manufacturing resources are needed at home and overseas. The percentage of casualties, compared with the total number of pilots and machines, is exceedingly heavy.

HIGH-POWERED ENGINES TELL THE TALE

"As regards the improvement in the quality of our aircraft, it is here that high-powered engines are beginning to tell their tale. Certain squadrons in which the machines are fitted with high-powered water-cooled engines have accounted for a considerable number of enemy airplanes, and yet few, if any, pilots or planes have been lost from such squadrons. The fact is that

speed and climbing power are counting more than ever, partly owing to the increased accuracy of machine-gun fire from enemy airplanes when they dare to attack, and partly owing to the growing necessity of flying higher and higher in order to avoid 'Archie,' the anti-aircraft weapons of the enemy having become much more serious in their attentions of late.

"I think it is now conceded by all students of the engineering side of aviation that water-cooled engines of greater power, and machines with, perhaps, not so high a factor of safety, but with better power of manœuvring and more adapted for faster flight, will be needed in larger numbers. The Germans are not going to sleep, and their manufacture of larger engines has been proceeded with for some time past.

"But if we find ourselves unable to break through the enemy's lines except at huge cost, we can at any rate fly through and possess his air and weaken his terrestrial obstructions and communications from his rear. This is what is beginning to happen. If this advantage is only pressed home with sufficient energy, superiority in the air, maintained and increased, in the coming twelve months, may be the deciding factor.

THE AIR BOARD AND THE FUTURE

"The future of the air services depends largely upon the Air Board. The increasing importance of aircraft must lead eventually to their being recognized more and more as worthy of an independent organization and executive, but the Air Board must be regarded as the germ of such an idea and as the special guardian of not only the present, but the future interests of the air services. The Air Board, having no real power, cannot yet be said to have become what it was hoped it would first develop into being. It should be remembered that it has no executive power, and that it is openly regarded by the Admiralty as a superfluity and a nuisance.

"If the Air Board in the next few weeks is not given more powers, and if it is asked to go on acting in a subsidiary and merely advisory capacity, there will be another crisis in the history of national aviation. The Government will find it difficult after two failures to appease the nation or Parliament by suggesting the appointment of yet a third body with no real powers, merely as a sop to clamour and as an excuse for delay.

"The Air Board should also be the authority which should begin at once to cultivate imperial ideas in regard to flying, and become the agency through which communications with the great Dominions should be carried on. In regard to Canada, this has already happened to a certain extent, but others of the great Dominion, up to a short time ago, at any rate, were dealing individually with the Admiralty or War Office, in some cases separate policies and organizations being discussed or even set up with little reference to the established policy decided here for war purposes.

"It is clear that the mother country will never be able to make war in the future, at any rate on a big scale, without the assistance of her grown-up and sturdy children. This point of view must be considered in a special degree in a new service like flying. The facilities for training which many of the Dominions possess exceed ours both in climate and country. To take one instance alone, it is difficult to train pilots in England during the winter, but in overseas climates, in Egypt and India, in Australia, at the Cape, and in New Zealand, even in Canada, the unfavorable meteorological conditions do not exist, and it is interesting to note, for instance, that Lieutenant Robinson, V. C., like Lieutenant Warneford, V. C., was of Anglo-Saxon origin.

"Again the competition of the best inventors, designers and engineers in the great Dominions will be valuable. Most of our own great firms move slowly in the direction of improving their existing designs, and Government departments are even slower. I am convinced that to set up a huge Government airplane or aero-engine factory would be a mistake tending to stagnation of design and the killing of new ideas.

"A word must also be said about our airship policy, or, rather, the lack of it. It would be unfair to blame for our present unfortunate position those gallant and far-seeing officers, mainly connected with the navy, who have for years foreseen what the development of air ships would mean to the fleet, and who have vainly endeavored to convince their official superiors. Professional jealousy, and, above all, obstinate disbelief in the need for airships, have been the root of the trouble, and to-day our fleet has not efficient airships to act as eyes in the North Sea or elsewhere. The whole airship policy of this country has been one of continual wobble since 1908. But the War office, at any rate, must be held blameless since July, 1914, for from that date all airship policy and construction were handed over to the Admiralty.

"In years to come the invasion of our shores by hundreds of airships and thousands of airplanes will be possible by nations over the sea many miles away, and may occur at any time without an actual declaration of war. It is obvious, therefore, that the vigilance of an air coastguard will be always needed. In the future it is not only on our fleet that this rountry will depend for safety, but on an imperial air service."

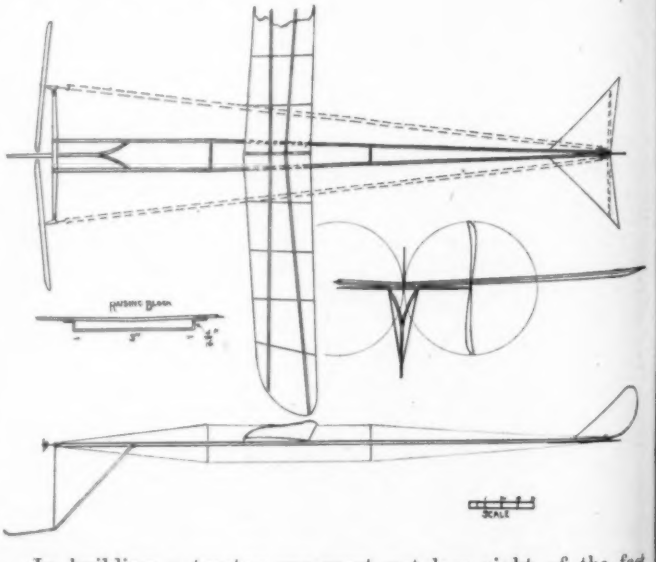
A Two Propeller Tractor Model

Owing to the small amount of experimenting along this interesting branch of model building, there has been little of account done in a field that promises to show astonishing results. Practically all of the tractor models built have followed very closely the scale types, resulting in short flights if any at all. This is due to falling off of the power at the end of the flights, and the difficulty in balancing a model of this type. Attention to detail in design and principles have been neglected, and naturally after several failures most model builders have turned to the old stand-by, the two propeller pusher.

Until last summer there had been very few flights of over a few feet with a tractor. Then a young man from Chicago, Mr. Little, came forward with a new principle in design and a very efficient flyer, setting records that had not been equalled by the two propeller machines.

The old tractor models would rise steeply at the start of a flight, level out, fly a short distance, and as the power died out would invariably dive nose first, resulting usually in a smashed propeller. To overcome the tendency to dive, which was caused by the action of the "slip stream" of air from the propeller on the wing, a wide plane with a very narrow chord was designed. The advantage of this was that most of the lifting surface was outside of the diameter of the propeller, and working in undisturbed air. The wing was placed over the center of balance, which was far enough behind the propeller to reduce the action of the "slip stream" to a certain extent.

The torque of the propeller had to be taken into consideration, and most of the models used high pitch large diameter propellers turning at a slow speed. This naturally gave an unusual amount of torque, resulting in the model swinging sideways, and was in a good many cases directly responsible for bad smashes. It had been noticed that the man carrying machines used small high speed propellers with a low pitch as compared with those used on models. This plan was adopted with very satisfactory results.



In building a tractor one must not lose sight of the fact that lightness is one of the most important factors. To carry out the design and to produce an efficient model, everything must be reduced to the simplest form to bring the weight down and to reduce head resistance. The accompanying drawing and descriptions show a two propeller tractor. This type of model is practically unknown, although it offers a field open for experimenting. Model builders have sidestepped this type because of the trouble with the one propeller machines.

BODY

The body is built up of two main longitudinals of spruce or white pine ⅛ x ¼ x 34 inches, forming a point at the rear, and spread to 2 inches at the nose. The front end of each stick is slotted to take the bamboo crosspiece or propeller hanger, which is 8 x ½ x ⅛ inches, cut to stream-line form. There are two bamboo cross braces, also stream-line form, which form the mounting for the masts holding the wire bracing on top and bottom of the body.

The landing gear is of the one skid variety, braced from the front ends of the body members by a V 5½ inches long made of steel wire. The skid proper is made of bamboo bent to shape, projecting 3 inches beyond the V and joining the body 4½ inches behind the front crosspiece. The rear end of the skid is split down about 3 inches and spread to a fork, so as to fasten to both sides of the body.

WINGS

The main plane has a spread of 32 inches, with a chord of 4 inches at the center, tapering to 3½ inches at the tips. It has a slight dihedral angle, is swept back, and has a small negative angle at the wing tips. The wing is of the double surface type, built up with two main beams 1/16 x 3/16 inches, bent at the center to form the dihedral, and in the case of the rear beam swept back so as to meet the wing tips near the trailing edge. There are ten ribs spaced at intervals of 3 inches. The entering and trailing edges are bamboo. Under the entering edge at the center of the plane is bound an incidence or raising block of steel wire 3 inches long by 3/16 inch high.

The tail is of the fan type, 4 inches from the front to rear, and 9 inches wide. It is perfectly flat and bound to the under side of the body. Directly above this and on top of the body is the vertical rudder, 5 inches long by 2 inches wide and mounted so as to project 2 inches behind the end of the body.

PROPELLERS, ETC.

Two propellers 8 inches long are driven by from two to six strands of ⅛-inch flat rubber. The propellers are cut from blocks of white pine 8 x ½ x ⅞ inches, and are of what is known as the expanding pitch type. The bearings are made of brass tubing with a piece of brass ¼ x 1½ inches bent and soldered on to form a V. Either steel wire or heavy hairpins can be used for shafting hooks, etc. The wings are covered with fiber paper treated with "dope" made of amyl acetate and celluloid. This will tighten the paper and waterproof it.

This model, after being carefully adjusted and balanced, has possibilities of being a very interesting flyer, with the possibility of making flights of considerable length and duration.

Allies Ordering 6275 Hispano-Suiza Engines

According to *España Automòvil y Aeronautica*, issue of October 30, 1916, the Hispano-Suiza Works of Paris and Barcelona are building 2,000 150 horsepower aero-engines for use with the French and Spanish aviation services, and additional orders aggregating 4,275 engines of the same model have been awarded to the following concessionaires:

FRANCE

Société des Automobiles Ariès, Paris	400	engines
Société des Automobiles Brasier, Paris	600	"
Etablissements Doriot-Flandrin, Paris	375	"
Leflaive et Cie, Saint-Etienne	300	"
Société des Automobiles Peugeot, Paris	500	"
Aéroplanes Voisin, Paris	200	"
Total:	2,375	engines

GREAT BRITAIN

Royal Aircraft Factory	200	engines

ITALY

Società Ceirano Automobili Torino	200	engines

RUSSIA

Russian War Office	500	engines

UNITED STATES

General Aeronautic Co. of America, Inc. (Wright-Martin Aircraft Corp.), New York	1,000	engines
Grand total:	4,275	engines

The accompanying table list gives the principal dimensions and data of the French and British military airplanes and seaplanes which are fitted with 150 horsepower Hispano-Suiza engines.

The Hispano-Suiza Works are also about to place on the market an eight-cylinder V-type aircraft engine developing 200 horsepower which will be practically identical with their 150 horsepower model, but for a geared down drive. This new engine will be fitted to the following airplanes which are now building in France:

Blériot, four-engined; Bréguet, single and twin-engined bombing airplanes; Caudron, two-engined; Donnet, seaplane; Delaunay-Belleville, two-engined; Farman, two-seater reconnaissance airplane; F. B. A., seaplane; Morane-Saulnier, twin-engined airplane; Nieuport, two-seater reconnaissance airplane; S. P. A. D., two-seater single and twin-engined pursuit airplanes; Tellier, seaplane; Voisin, four-engined bombardment airplane.

Docking Dirigibles

Great dirigibles are no longer docked by manual labor. It takes to hold a big Zeppelin at the entrance to its shed, immovable against the wind, almost as many men as would suffice to hold a steamer against the tide, according to the Boston *Transcript*. The lateral air movement imperils the Zeppelin by threatening to jam it against the shed. To anchor it to the ground against any side pull while it is moved ahead, the means chosen is to lay a single rail on either side running into the shed in the direction of the ship's course in entering, with four-wheeled clamps rolling easily along these rails and made fast to her sides with lines. Instead of a great crowd of men pulling at the ship direct, a handful pull at these clamps, and roll the ship into her harbor; and she is held more securely than she ever could have been before. The running in and out of the shed is performed expeditiously, two of the propellers even being used occasionally to speed the ship along. The purpose of this maneuver is to take advantage of any short lull in the wind.

Make	Type	Area (sq. m.)	Useful load (kg.)	Rev. per min.	Horiz. speed (km.)	Climbing speed		
						1000 m.	2000 m.	3000 m.
Nieuport	Two-seater tractor biplane	30	375	1,500	157	4′ 45″	12′ 20″	25′ 3″
F. B. A.	Two-seater seaplane	42	425	1,520	143	6′ 40″	14′ 50″	22′ 30″
F. B. A.	Two-seater seaplane	42	500	1,250	143	7′ —	18′ —	...
B. E. (British)	Two-seater tractor biplane	32	300	1,600	160	3′ 50″	9′ 4″	16′ —
Donnet	Two-seater seaplane	37	500	1,580	140	9′ —	22′ —	...
S. P. A. D.	One-seater pursuit monoplane	18	210	1,700	200	3′ —	6′ —	10′ 30″
Blériot	One-seater pursuit monoplane	18	210	1,700	200	3′ —	6′ —	10′ 30″
Letord*	Two-seater biplane	56	550	1,600	...	...	...	...
Caudron	Two-seater biplane	64	625	1,550	142	7′ 10″	17′ —	28′ 40″
Demonge*	Two-seater biplane	28	280	1,600	...	...	...	...
Nieuport†	Single-seater tractor biplane	35	350	1,500	...	...	...	...
Nieuport†	Twin-engined biplane	60	600	1,500	...	...	...	...
Morane†	Twin-engined tractor	55	...	...	...	...	...	...
Sopwith†	Two-seater tractor biplane	32	250	...	...	...	...	...

* Trials proceeding. † Building.

Course in Aerodynamics and Airplane Design*

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PART 1—SECTION 10

Resistance of Various Airplane Parts

One of the most difficult problems in aeronautical design is the prediction of the total resistance of the machine. The wind tunnel test is a good check, but it is most important to assign resistance values to various parts and to tabulate them prior even to the construction of the model. In this section have been collected as far as possible all the data available for bodies, radiators, fittings, wheels, cables and wires and certain other miscellaneous objects.

Airplane Bodies from the Aerodynamical Point of View

If airplane bodies were designed from a purely aerodynamical point of view, they would follow dirigible practice and be of streamline form. There are, however, a number of structural requirements which have to be met, which preclude

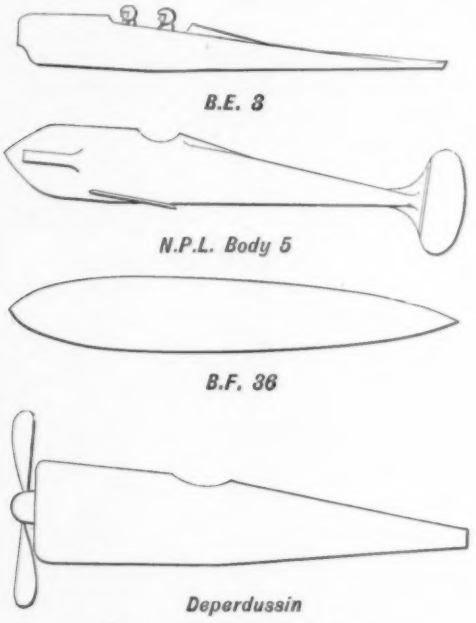


FIG. 1. TRACTOR BODIES.

the employment of such forms. The body must enclose the power plant and the personnel, the length must be long enough to place the rudders well clear of the wash of the planes, the shape of the body must conform to structural requirements such as the use of four longitudinal girders, or a triangular form which has been found to be advantageous in steel construction.

No wind tunnel tests on bodies alone can determine exactly their resistance on an airplane, because the question is complicated by the position and form of the motor, and the disposition of the tail surfaces. The propeller in a tractor machine also introduces three possible variations in drag coefficients: (1) when the propeller is pulling and there is a slip stream of velocity greater than the airplane velocity, (2) the resistance on a glide when the engine is shut down, but the propeller is revolving as an air motor; (3) when the propeller is not revolving at all, the engine being held.

* This Course commenced in the August 1, 1916 issue of AVIATION AND AERONAUTICAL ENGINEERING, will be completed in 24 issues. It will embody the fundamental aeronautical data necessary for airplane design, and present the design of standard machines in complete, simple and systematic form.

Tractor Bodies

In Table 1 is given a comparative table of resistance coefficients for area in normal presentation of a number of airplane bodies, and in Fig. 1 are shown sketches of the same bodies. Exact comparisons are impossible because some of the bodies are made for two men and others for one. Still qualitative conclusions can be drawn. The N. P. L. Model 5, more symmetrical than the B. E. 3, shows a distinct improvement over the latter which is somewhat discounted by the fact that the B. E. 3 carries two men unshielded. The B. F. 36, an almost perfect dirigible form, is markedly better than either of these two bodies.

The resistance of the body in an airplane is apparently a small quantity, but the figures given below do not represent the resistance of a body in full flight where it is increased by 40 per cent the propeller slip stream increasing the relative speed of the air by some 25 per cent. Also, it must be remembered that with a best glide of 1 in 8, a 5-pound increase in resistance is practically equivalent to an added weight of 40 pounds. A blunt, square form of body such as is often seen in American practice may increase resistance even more, and better aerodynamical design of bodies seems a feature worth considering.

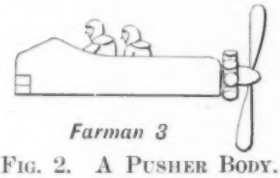


FIG. 2. A PUSHER BODY.

TABLE 1.

COMPARATIVE TABLE FOR TRACTOR BODIES.

Designation.	Coefficient of resistance, K where $R = KAV^2$ (A = area in normal presentation in square feet V = miles per hour; R = drag in lbs.)	Length / maximum depth.	Resistance for a body of 8 square feet normal presentation at a speed of 60 m. p. h.
British B. E. 3 (with 2 men)	.000720	7.35	20.7
N. P. L. Model 5	.000420 (approx.)	5.50	12.0
British B. F. 36 (dirigible form)	.000258	5.75	7.4
Deperdussin (enclosing rotary motor)	.000541	5.6	15.6

TABLE 2.

COMPARATIVE TABLE FOR PUSHER BODIES.

Designation.	Coefficient of resistance K where $R = KAV^2$ (A = maximum area in normal presentation in square feet; V = miles per hour; R = drag in lbs.)	Length.	Resistance for a body of 8 square feet normal presentation, at a speed of 60 m. p. h.
N. P. L. Model Body 3 (fairly symmetrical section)	.000271	3	7.8
Farman 3 (body in form of a boat, two men unshielded)	.000845	3.2	24.4

Pusher Bodies

A pusher body such as the Farman 3, illustrated in Fig. 2, gives a much smaller resistance than the tractor bodies, but when the head resistance of the uncovered outriggers is taken into account, it will probably be found that pusher arrangements offer considerably more resistance than tractor bodies.

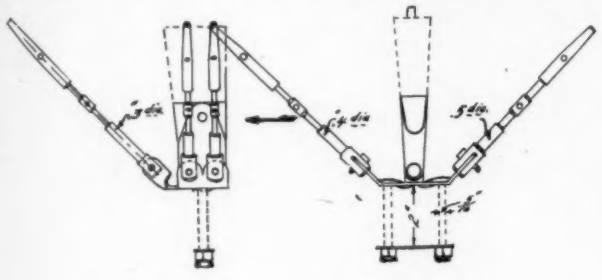
Radiator Resistance

The only values available for this are the results of some tests at the Massachusetts Institute of Technology. These were carried out on portions of a radiator of the honeycomb

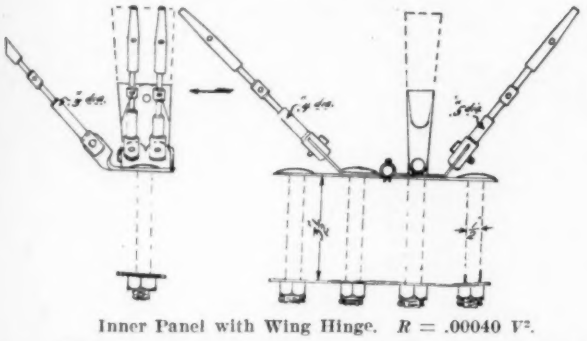
type having sixteen ¼-inch cells to each square inch of the surface normal to the wind. The tests were repeated on two sizes of radiator section, one 0.25 square feet and the other 0.111 square feet, and at various wind speeds. No important variation in the resistance coefficient was apparent and the average coefficient may be used for practical calculations. This has a value $K_x = .000814$ pounds per square foot of projected area per foot per second or .00173 pounds per square foot of projected area per mile per hour.

Resistance of Fittings

Fittings are so variable in design that it is impossible to give definite figures to meet every type of wing strut fitting. Tests were conducted at the Massachusetts Institute of Technology, on the fittings of which dimensions drawings are given in Fig. 3, the coefficients of resistance are $R = .00030\ V^2$ and $R = .00040\ V^2$ for the two types which at 60 miles an hour



Outer Panel. $R = .00030\ V^2$.



Inner Panel with Wing Hinge. $R = .00040\ V^2$.

FIG. 3. FITTINGS EMPLOYED IN TESTS FOR HEAD RESISTANCE AT MASSACHUSETTS INSTITUTE OF TECHNOLOGY

CLARK STRUT FITTINGS. Resistance includes fitting, five turnbuckles and nuts but not dotted portions as indicated on drawings. Resistance in pounds; Velocity in miles per hour.

gives 1.07 and 1.44 pounds respectively. Such figures will be at least approximately correct in design.

Resistance of Airplane Wheels

For a standard airplane wheel of about 26 x 4 inches in size, the drag found by the N. P. L. is about 17 pounds at 60 miles per hour. This again is sufficiently accurate for practical purposes. Eiffel has experimented with a number of wheels and shown that no great variation need be expected from the above value. An important result from the French experiments was the fact that an uncovered wheel had a resistance of 50 per cent more than a covered wheel of similar dimensions. This justifies the standard practice of covering the wheel in.

Resistance of Wires and Methods of Plotting

A certain complication is necessary in the methods of plotting the results for the resistance of cables and wires. As we have seen from the diagram of Fig. 19, in Section 3, of the Course, the resistance of a wire or any cylindrical body is partly due to turbulence, partly due to skin friction. It cannot therefore be represented by such a simple expression as $R = KAV^2$ as for a wing, but by an expression involving Reynolds' number, $R = KAV^2 f\left(\frac{\nu}{DV}\right)$, or if we replace the area of a wire by LD where D = diameter and L is length in feet, then $R = KLD\ V^2 f\left(\frac{\nu}{DV}\right)$. Since ν, the coefficient of kinematic viscosity is constant for air, we can simplify this expression by writing:

$$R = KLD\ V^2\ F(VD).$$

We do not know what the function $F(VD)$ is exactly, nor how it varies with size and scale except from experimental results and comparisons of resistance varying as $LD\ V^2$ can only be made between two cables if VD is a constant. If K is taken as a function of VD, then R may be written $R = KLD\ V^2$ but then K must be plotted against VD in analyzing experimental results. This is the only rational and scientific method.

An empirical method, however, is sometimes employed with fair accuracy of plotting the resistance of a wire whose length is equal to its diameter against $V^2\ D^2$. This has the advantage that the graph approximates very closely to a straight line, the slope of which is equal to K, thus giving an easy means of determining a mean value of K.

Resistance of Stationary Smooth Wires

The most accurate researches have been carried out at the

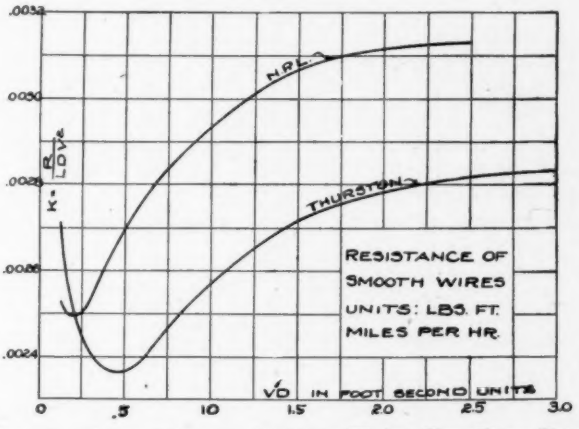


FIG. 4. RESISTANCE OF SMOOTH WIRES PER FOOT RUN.

N. P. L. and their results are shown in Fig. 4 plotted against $V'D$. In the expression $K = \frac{R}{LDV^2}$. R is in pounds, L in feet, D in feet, and V in miles per hour. But in the abscissae, values of $V'D$, V' is in feet per second, and D in feet, so as to give the correct scale and speed relationships which must be in the same units.

The accuracy of the curve at its lowest portion is doubtful, since the flow is apparently just changing its nature at that point, and successive observations under the same conditions may give quite different results. On modern machines of fairly high speed, however, the values of $V'D$ nearly always exceed 0.35 and consequently, do not lie on this section of the curve.

Similar tests were made by Mr. Thurston and M. Eiffel, and the values obtained by the former are plotted in the same figure. Thurston's experiments, however, were very much earlier, and Eiffel's covered a less range and were performed with less sensitive apparatus, so it is advisable to use the N.P.L. results.

Resistance of Vibrating Wires

When the question of resistance first began to arouse interest, it was popularly supposed that a vibrating wire had much greater resistance than a stationary one. This, however, is not the case. Research on this point at the N.P.L. failed to disclose any difference whatever, although the balance would have shown deviations as small as 3 per cent, even for the extremely small forces under consideration. Mr. Thurston, on the other hand, concluded that vibration at the rate of 15 per second increased the resistance by about 5 per cent for small wires and by a somewhat smaller percentage for those of larger diameter. In any case, the effect is unimportant.

Resistance of Stranded Wires

The air resistance of stranded wires was also investigated at the N.P.L., and was found to be about 20 per cent greater than that for a smooth wire of the some diameter. This is

only approximate, as the coefficient depends on the number of strands, type of lay, etc. It is also impossible to plot the values of K against VD for wire rope, as the VD law holds good only for objects which possess strict geometrical similarity, a thing which stranded wires of different sizes never do.

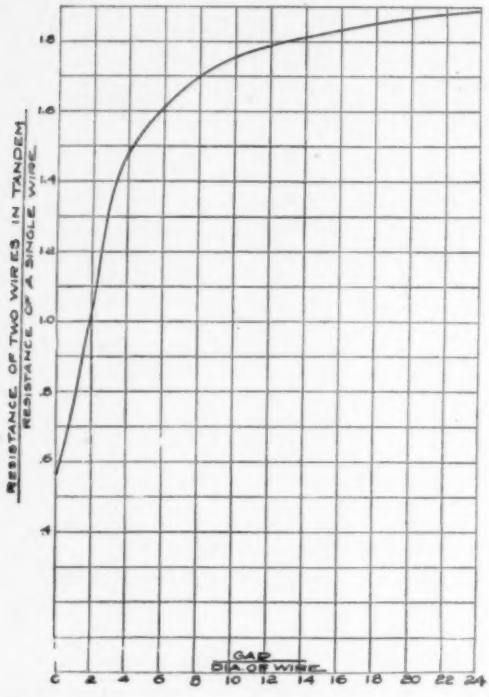


FIG. 5. RESISTANCE OF WIRES IN TANDEM AS A RATIO OF THE RESISTANCE OF A SINGLE WIRE.

Resistance of Wires Placed Behind One Another

The manner in which resistance is affected by the close juxtaposition of two wires, one behind the other, is a point of great interest. Here, too, it is at present necessary to rely on Mr. Thurston, although we hope to be able soon to present the results of some more extensive and accurate tests on this matter.

Fig. 5 gives, in terms of the resistance of a single bar, the resistance of two bars or wires separated by various distances. It will be seen that two wires placed one behind the other and spaced from 5 to 9 diameters apart, as is usual in double-wiring a biplane cellule, have from 60 per cent to 75 per cent more resistance than a single wire. The force is, however, materially less than for the two wires placed side by side.

Resistance of Inclined Wires

Eiffel has experimented on the resistance of inclined wires. As would be expected the resistance of a wire progressively decreases as its angle with the wind diminishes. Table 3 gives correcting values.

TABLE 3.

Angle of a wire to the wind.	Ratio of resistance to that of a wire at 90 degrees to the wind.
90 degrees.	1.00
75 degrees.	0.92
60 degrees.	0.70
45 degrees.	0.46
30 degrees.	0.20

Suggestions for Stream-lining Wires

It has been suggested from time to time that wire resistance should be decreased by "stream-lining" or adding a triangular portion in back of the wire. From experiments by Ogilvie, however, it appears that a section made up of a semi-circle and a triangle has a decidedly high resistance, and the gain from such a procedure would be small.

Wires placed behind one another have also been covered in. The British Royal Aircraft Factory produces a very heavy R.A.F. wire in use on big machines which is stream-line in form. But the direction in which progress manifests itself at present is in the elimination of wires by certain modern trussing such as used in the recent Curtiss biplane.

Resistance of Miscellaneous Objects

The resistance of certain miscellaneous objects as deduced by Eiffel may sometimes be useful. The values for such objects within certain limits are illustrated in Fig. 6.

Object	K for pounds per square foot per mile hour units	Limits $V D$ in foot second units	Attitude
Sphere	0.000445	$V D > 32$	→ D
Hemispherical Shell	0.003840	$V D > 11$	→ D
Hemispherical Shell	0.008100	$V D > 22$	→ D
Circular Disk	0.002820	$V D > 22$	→ D
Cone Closed Base	0.001300		→ 60° D
Cone Closed Base	0.000850		→ 30° D
Cone Hemispherical End	0.000406		→ 20° D
Cone Hemispherical End	0.000222		→ D 20°

FIG. 6. RESISTANCE OF MISCELLANEOUS OBJECTS (AFTER EIFFEL)

References for Section 10

AIRPLANE BODIES.

British Report 1911-1912, page 52.
British Report 1912-1913, page 116.
La Resistance de l'Air et l'Aviation, Eiffel, 1914, page 250.

AIRPLANE WHEELS.

British Report 1912-1913, page 122.
La Resistance de l'Air et l'Aviation, Eiffel, page 256.

WIRE AND CABLES.

Aerodynamic Resistance of Struts, Bars and Wires, by A. P. Thurston, *Aeronautical Journal*, April and July, 1912.
British Report 1910-1911.
La Resistance de l'Air et l'Aviation, Eiffel, page 97.
New Mechanical Engineers' Handbook, Section on Aeronautics, by J. C. Hunsaker.

Aeronautical Patents

Copies of these patents may be obtained for five cents each by addressing the "Commissioner of Patents, Washington, D. C."

ISSUED NOVEMBER 28, 1916.

1,206,435. Filed September 18, 1914. To Elias S. Hall, Millstone, N. J. An airplane.

1,206,680. Filed August 26, 1910. To William E. Dennis, Far Rockaway, and Harry S. Bretton, Long Island City, N. Y., assignors by mesne assignments to American Aerocar Holding Corporation, Richmond Hill, N. Y. An airplane with driving motor, aviator's seat and fuel carrying means, all mounted upon a carriage in such a way that the carriage and its load serves as a weighted stabilizing pendulum.

1,206,733. Filed June 29, 1916. To James McKechnie, Barrows in Furness, England, assignor to Vickers, Ltd., London, England. In an internal combustion engine means for cooling piston rods and pistons through a tubular piston rod.

1,206,608. Filed January 24, 1916. To Don Fuller Smith, Corry, Pa. A two-stroke, double-acting rotary valve internal combustion engine.

1,206,094. Filed August 12, 1914. To Francis E. Collinson, assignor of one-half to Taylor Instrument Companies, Rochester, N. Y., a corporation of New York. A barometer.

ISSUED DECEMBER 5, 1916.

1,207,666. Filed November 14, 1916. To Willis M. Thompkins, Lonoak, Cal. A rotary internal combustion engine.

1,207,373. Filed June 24, 1915. To Henry Coakley, New York, N. Y. An airplane stable in three directions.

1,207,492. Filed May 12, 1916. To Frederick W. Buck, Flagler, Colo. Airplane structure combined with a torpedo and means for releasing the torpedo.

News of the Fortnight

$100,000 Asked for Aerial Postal Experimentation

The annual report of the Postmaster-General, made public in Washington on December 9, has this to say of the possibilities of aerial mail service:

"The remarkable development of the airplane has emphasized the purpose of the department to utilize it as an agency for the extension of the mail service wherever practicable.

"Advertisements were issued during the year inviting bids for airplane service on one route in Massachusetts, and on several in Alaska. Inability of possible bidders to obtain specially constructed airplanes for the proposed aerial mail service rendered the efforts of the department for the time without results. However, negotiations with airplane manufacturers are still in progress. At the same time the department is cooperating fully with the National Advisory Committee for Aeronautics looking to the establishment of a carefully conducted experimental aerial mail service.

"The department has also noted with interest the effort to transport mail from Chicago to New York by airplane.

"From published reports of aerial operations abroad it would apear that the dirigible balloon type of airship had been so perfected that it would convey great weight. In fact, the last statements that appear in connection with the subject assert that 300 passengers may be carried in an airship. This would approximate fifteen tons net weight.

"The department is interested in determining the practicability of this method of transportation with a view to its utilization. It is suggested that authorization be given for experiments to be made with this type of conveyor. For aerial experimentations an appropriation of $100,000 is recommended."

The Aeronautical Society Banquet to Col. Squier

On Tuesday evening, November 28, the Aeronautical Society of America gave a banquet at the St. Regis Hotel, New York, in honor of Lieutenant-Colonel George O. Squier, in charge of the Aviation Section of the Signal Corps, U. S. A. Colonel Squier outlined the plans of the Aviation Section briefly. He told of the fact that every effort was being made by the Army officers in Washington to develop American aeronautics by using every legal means to encourage the manufacture of machines and the training of pilots. He told of the officers' efforts to secure sites for aeronautical proving grounds in the East and in the West, and he said that if he had any influence "one of the proving grounds will be called Langley Field." He then stated some research problems confronting those interested in the development of American aeronautics. (See AVIATION AND AERONAUTICAL ENGINEERING, December 1, page 287.)

William L. Saunders, a member of the Naval Consulting Board and formerly president of the American Institute of Mining Engineers, said in complimenting Colonel Squier and his aids:

"If we needed to be reminded that Colonel Squier is a great man we would have found such a reminder in the attacks that have been made on him by certain members of the Aero Club of America. I speak as one of the oldest members of the Aero Club. It is the fate of genius to be maligned."

Capt. R. C. Bolling of the First Aero Company, N. G,. N. Y., said in lauding the Army officers that those who complain about them might better turn to those who worked with them in the Federalized National Guard for information. It will be a long time before any of the members of the First Aero Company, N. G., N. Y., complain of the treatment accorded them by officers of the regular service, he said.

Other speakers were Thomas R. Macmechen and Glenn L. Martin. F. W. Barker, president of the Aeronautical Society, presided.

Samuel H. Valentine Left $10,000 for Aeronautics

Samuel H. Valentine, lawyer, who died September 15, leaving an estate of more than $200,000, gave $10,000 to the Aero Club of America, for use as prizes. Mr. Valentine was a member of the Board of Governors of the club.

The money has been left to the club to establish a prize or prizes for the encouragement of "aircraft which shall not use gasoline as a fuel."

Orville Wright's New Stabilizer Almost Perfected

The airplane made as safe as the automobile, according to newspaper reports, is the dream of Orville Wright, who, with his brother Wilbur, now dead, gave man dominion over the air a decade and a half ago. That dream is said to have become a reality with his new stabilizer, for which patents are to be applied for within a few weeks.

Never prone to talk much, Orville Wright is even more reticent than usual on the topic of his latest invention. With patents not obtained, naturally he will not divulge secrets until it is assured that he will reap the rewards of the service. On the question of what it will do, however, he is not so secretive. He believes aircraft will be as safely and easily piloted as the most humble "flivver."

His new stabilizer uses gravity instead of the gyroscopic principle for its working. Instead it enters the domain of electricity. By a unique arrangement of batteries, augmented by a pendulum swinging in a liquid bath and a minor propeller placed almost directly over the pilot's head, absolute unswerving, automatic stability is said to be maintained.

Weather conditions of early November were excellent for flying and while Aviator Victor Carlstrom was driving his big 200 horsepower machine from Chicago to New York, Mr. Wright, inventor of the first heavier-than-air flying machine, was perfecting his invention in a series of flights on the aviation field east of Dayton.

For the first time in more than three years Mr. Wright made an aerial flight. Almost daily for a period of two weeks he made flights and continued tests. Time after time he brought the machine to earth to make some slight change in the mechanism of the stabilizer. One time it was the tightening of a bolt, another the loosening of a wire and still another, the overhauling of the entire device.

It was following the end of one of these flights that he exclaimed, "I'm more than satisfied with its work now. All I had to do was to steer the machine. The stabilizer gave me a perfect balance during the entire flight. It did all the 'banking' on the turns and righted the machine on every dip."

When asked if the new stabilizer was in any way similar to the one patented some time ago, he replied that the first device was not to be compared to the new one.

The Coast Guard Report

Captain E. P. Bertholf of the Coast Guard Service, in his annual report as commandant to the Secretary of the Treasury, mentions the value of aviation in connection with Coast Guard Service. He reports to Secretary McAdoo that airplanes might be used to carry lines to stranded ships "when the shipwreck occurs too far from the shore to be reached by the line-throwing gun and the state of the sea makes it impossible to use the service boats." Airplanes may also be useful in locating derelicts quickly and "the fact must not be overlooked that aviation facilities provided for the Coast Guard will be a valuable addition to naval aviation equipment in time of war."

With these possible uses in view Congress is being asked to appropriate money for aviation in the Coast Guard at its present session. Congress will be asked to pass an emergency appropriation this year of $147,000, to be made available before the close of the fiscal year on June 30, 1917. This proposed appropriation is to be supplemented by one of $255,000 to be available for the fiscal year ending June 30, 1918. The appropriations are itemized as follows:

FOR FISCAL YEAR ENDING JUNE 30, 1917.	
Machines and equipment	$80,000
One station	40,000
Personnel	27,000
	$147,000
FOR FISCAL YEAR ENDING JUNE 30, 1918	
Personnel	$40,000
Equipment	115,000
Stations	100,000
	$255,000

Anticipating the appropriation of these sums, four officers and eight enlisted men are at Pensacola, Fla., receiving instruction and one officer and two men are at Hammondsport, N. Y. The officers at Pensacola are Lieutenants C. E. Snyden, C. A. Coffin, Robert Donohue, and E. F. Stone. Lieutenant N. B. Hall is at Hammondsport.

Copyright by Underwood & Underwood, New York

Aviator Victor Carlstrom as he looked when he landed in New York City

Conquering the Air For Business

The biplane of the *New York Times*, making its recent mail-carrying flight from Chicago to New York, was equipped with Goodyear Shock Absorbers and Goodyear Cord Tires.

Its effort-crowning flight is not merely another flight; it initiates the conquest of the air for American Business.

But its endorsement of Goodyear aeroplane equipment, is, after all, only another endorsement.

Ever since Goodyear Cord Tires for air-machines first appeared they have been used by the discriminating strivers for records, as well as by military aviators in our own and foreign armies, who demand the maximum of service and safety.

The reputation which extensive use has given them both here and abroad is not merely due to the fact that they are the *only* cord tires for air-machines.

Their superior workmanship and excellent materials have played no small part in the winning of their good name; just as they have established in favor everything made of rubber which Goodyear supplies for aeroplanes and balloons.

The Goodyear Tire & Rubber Co., Akron, O.

GOODYEAR
AKRON

Navy Wants Superzeppelin

Recent newspaper reports quote Secretary Daniels as having said that plans had been completed for the construction of a Zeppelin type of dirigible airship for the Navy, and that his intention was soon to call for bids. In the preparation of the plans the department has taken advantage of information received from our Naval attachés abroad as well as information obtained as a result of the destruction of German Zeppelins that have fallen in England and Scandinavian countries.

Parts of destroyed Zeppelins which have been sent to Washington by our Naval attachés have been examined in the effort to perfect the plans for the first real dirigible to be constructed for the Navy. The chief difficulty confronting the department is its inability to discover any American firm that is as yet qualified to build a large dirigible of the Zeppelin type.

The Navy Department has been conferring with various concerns with a view to encouraging them to submit proposals and to develop their plants so as to undertake the construction of the dirigible that has been designed by the Navy. Congress has appropriated $500,000, which may be used by the department in payment for its construction.

It is understood at present that more than one American firm is carrying on experimentation with a view to constructing a large rigid dirigible in the near future.

American Aircraft Company and U. S. V. N. R.

"The United States Volunteer Naval Reserve" and "The American Aircraft Company," both with offices at 1655 Broadway, New York City, have been the subject of newspaper articles during the past fortnight.

Commandant Usher of the New York Navy Yard recently laid before Secretary of the Navy Daniels correspondence alleging that the "United States Volunteer Naval Reserve" was apparently using the United States Navy uniform without authorization. Admiral Usher's correspondence has been laid before Attorney-General Gregory for investigation by Secretary Daniels.

"Lieutenant" Steinmetz of "The United States Volunteer Naval Reserve" stated over the telephone to a representative of AVIATION AND AERONAUTICAL ENGINEERING that he did not "at the present time" hold any commission from the United States authorities, but said that the United States Volunteer Naval Reserve had received the endorsement of Secretary Daniels in a personal letter to one of its officers. The function of the "United States Volunteer Naval Reserve" was explained to be instructing recruits in the school of the soldier and giving them lectures on aerodynamics.

The American Aircraft Company, which was incorporated under the laws of the state of Delaware, last July, with a capitalization of $5,000,000 and shares at a par value of $5, also has offices at 1655 Broadway. J. O. Stewart & Company, investment brokers, advertised the stock under the caption "New York to London in 30 Hours," and the incorporators said that the flight would be made in seaplanes of the company's own manufacture.

Possible Transatlantic Flight Next Spring

Lieutenant Kjell Nyegaard of Norway and Captain Hugo Sunstedt of Sweden were quoted upon their arrival in New York as saying, "We are going back by way of the air; otherwise we are not going back."

Capt. Sunstedt is one of Sweden's foremost aviators and holds the record for a flight between Stockholm and Paris, a distance of 1,600 kilometres, or approximately 1,000 miles, during which flight he said he was obliged to land once, for fuel. Lieutenant Nyegaard has been attached to the French Flying Corps.

Lieutenant Nyegaard used one of the diminutive biplanes in many of his flights and speaks enthusiastically of the machine, which he says has less than twenty feet spread and is equipped with a 110-horse-power motor, making it very speedy, and, incidentally, tricky; so much so, in fact, that very few were used.

These aviators hope to have a mammoth triplane built in this country, and, when it is completed, to fly across the Atlantic with it, the first leg of the proposed flight to be from New York to Newfoundland, the second to some place in Ireland and the third to France. They expect to receive one, or possibly two, of the small, speedy airplanes from Europe within the next month and an attempt to fly from New York to San Francisco may be made soon after.

Ruth Law Flew at Liberty Illumination

Miss Ruth Law, holder of the American non-stop cross-country flying record, shared the position of the center of interest at the ceremonies attendant upon the illumination of the Statue of Liberty with the statue itself and the President of the United States.

Flying the same little exhibition airplane in which she made her cross-country flight, but with illuminating flares afire on the trailing edges of both planes she went through about twenty minutes of aerial gymnastics, so startling that some who saw the flight said she had spelled out the word "Liberty" in letters of fire above the statue and the President's yacht *Mayflower*. She started from and landed upon Governor's Island.

Burgess Seaplane for Bay State

(C) *International Film Service.*

The Naval Militia of the State of Massachusetts was presented with this seaplane of the Dunne type by Eben S. Draper, at Marblehead.

National Advisory Committee Visited Mr. Joy's Field

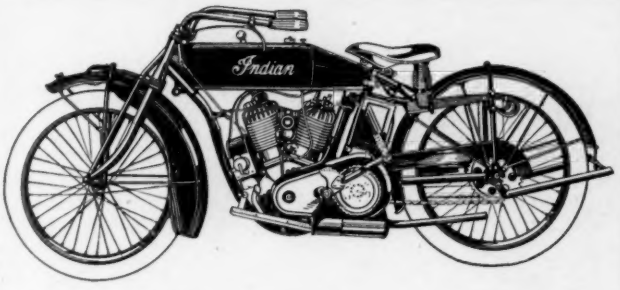
The aeronautic field which Henry B. Joy, chairman of the Board of Directors of the Packard Motor Car Company, has developed privately near Detroit within the last two years, occupied much of the attention of a committee of the National Advisory Committee for Aeronautics on its recent visit to Detroit in the course of a tour of the important manufacturing centers of the country.

The Army and Navy representatives, government officials and engineering scientists who made the inspection congratulated Mr. Joy warmly on his foresight in selecting the site, which is twenty-seven miles northeast of Detroit, a level expanse of 570 acres, on the shore of Lake St. Clair. It offers a splendid course for trials over both land and water.

The committee members were impressed with Detroit as a particularly appropriate location for a government aviation field, by reason of the unexampled facilities which it has for manufacturing internal combustion engines, and also because Detroit has an exceptional amount of engineering and mechanical talent available for piloting and maintaining air machines.

The Detroit meeting of the committee brought out that the use of aircraft will soon be a practical reality in the many services of the government and also in private industrial fields. It was predicted that just as it is possible to design a ship for a certain load capacity, speed and manoeuvring power, it will be possible to design an airplane with reference to load, speed and manoeuvring power.

The federal government has developed since 1910 a small body of highly skilled aviators. They have been trained not only for fighting, but in general navigation of the air. With the appropriations now available the increase in the number of trained aviators will be rapid, and the small body of officers referred to will be drawn on for teachers.



14 Indians for the Aviation Section Signal Corps, U. S. A.

The Aviation Section of the United States Army Signal Corps has ordered, for use by the Aero Squadrons, fourteen 1917

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SPRINGFIELD, MASSACHUSETTS

WITTEMANN-LEWIS AIRCRAFT COMPANY

Newark, N. J.

The company has removed its plant from Stapleton, S. I., to property adjoining Lincoln Highway and Passaic River, Newark.

The new plant has largely increased floor space and the latest equipment for building all types of aircraft. Land and water flying facilities at door of factory.

National Advisory Committee Meeting

At the December meeting of the Executive Committee of the National Advisory Committee for Aeronautics, the committee adopted the metric system as its standard, so far as the work of the committee is concerned, and recommendations will be sent to the various departments of the Government that this system be adopted in connection with all matters pertaining to aeronautics. The War Department will put this change into effect immediately in its Aviation Section, using both the metric and English systems on all drawings for a time.

It has been found necessary to amend and add to the nomenclature for aeronautics recently issued by the committee. The following changes were adopted at this meeting and will be incorporated into the report on nomenclature when published in the second annual report:

The question of what is a right-hand engine has occasioned a great deal of comment in the aeronautic industry, and in order to associate the words "right-hand" and "clockwise," the definition of a right-hand engine has been amended to read:

"A right-hand engine is one in which, when viewed from the output shaft, looking toward the output shaft end, the shaft is seen to rotate clockwise."

As it appeared necessary, on further consideration, to differentiate between aircraft designed for operation from land and those designed for operation from water, the committee adopted the term "seaplane" for airplanes in which the landing gear is suited to operation from the water. The term "airplane" is commonly used in a more restricted sense to refer to airplanes fitted with landing gear suited to operation from the land.

For "Dihedral in an airplane," the committee adopted the following definition:

"The angle included at the intersection of the imaginary surfaces containing the chords of the right and left wings (continued to the plane of symmetry if necessary). This angle is measured in a plane perpendicular to that intersection. The dihedral of the upper wing may, and frequently does, differ from that of the lower wing in a biplane."

The resignation of Naval Constructor H. C. Richardson, U. S. N., as secretary of the committee, on account of his transfer to duty at the Navy Aeronautic Station, Pensacola, Fla., as construction officer, was accepted. Pending the election of a permanent successor, Dr. S. W. Stratton, Director of the Bureau of Standards, was appointed temporary secretary.

Pan-American Aeronautic Exposition

Practically all of the leading aeronautical companies in the country have taken space in the Pan-American Aeronautic Exposition, which will take place at the Grand Central Palace, New York, during the week of February 8 to 15, 1917. The exposition will be held under the auspices of the Aero Club of America, the Pan-American Aeronautic Federation and the Society of Aeronautic Engineers.

Howard E. Coffin, chairman of the Organizing Committee of the exposition, has interested the Army and Navy in the exhibition, and it is announced that a representative display of military and naval equipment will be made.

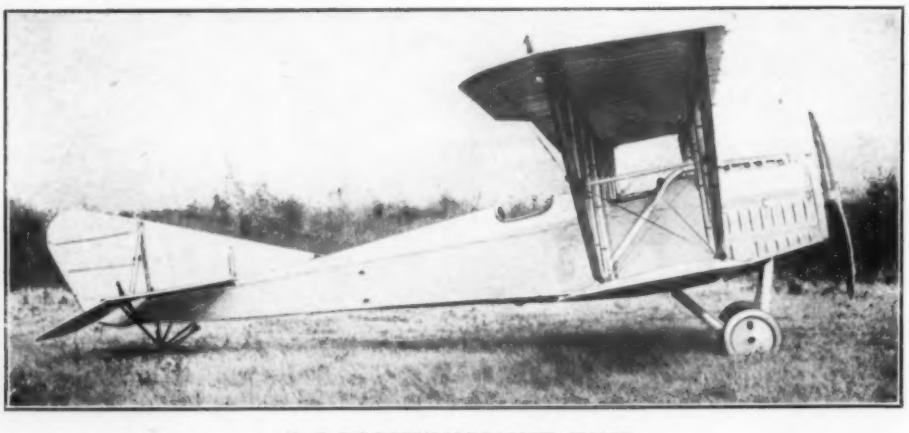
The exposition will come at a time when the interest in aeronautics in this country is greater than ever before and it will give the public a more complete idea of the extent of the aeronautical industry than could be had in any other way.

In the next issue of AVIATION AND AERONAUTICAL ENGINEERING, there will be a complete outline of the plans for making this exposition worthy of the industry.

Dimensions and Performances of Superzeppelins

Figures on the dimensions and performances of the latest superzeppelins that are apparently authentic are published in *Zeit.* Four ships have been built at Friedrichshafen and tested over Lake Constance of which the following data is of interest: Length, 240 meters; diameter, 23 meters; volumetric contents, 32,000 cubic meters; horsepower, 4,000 to 5,000 with eight motors; maximum climb, 4,000 meters; usual climb, 3,000 meters; maximum speed, 120 kilometers per hour. These dirigibles can carry a munition load of 6,000 to 7,000 kilograms.

THOMAS MILITARY TRACTORS



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Airplane Offered to Captain Amundsen

Captain Roald Amundsen, the Norwegian explorer, who has successfully reached the South Pole, announced upon his arrival in the United States that he was preparing a north polar expedition and was contemplating the use of an airplane to supplement his other exploring work.

Harry Bowers Mingle, president of the Standard Aero Corporation, offered to present Captain Amundsen with a specially designed machine. Captain Amundsen has been a pilot for some years.

The airplane will be used to make wide range explorations and to pick out suitable places for carrying on the work of gathering data on soundings and currents which is the scientific justification of polar exploration.

(C) Underwood & Underwood

The new French double-barreled aerial gun which revolves on a semi-circular bracket to give a wide angle of operation.

Book Review

SMALL FACTORY OUTPUT AND HOW TO SPEED IT

By George H. Mansfield

(McBride, Nast & Company, London. Pp. 64.)

This book does not deal specifically with airplane construction, but the methods which it describes are readily applicable to airplane work. It has, in fact, been written in view of the hurried work which airplane factories in Great Britain are having to face during the present war. The hand-book deals with such matters as arrangement of factory departments; selection of men and charge-hands; tools, stores and instruments; work-taking and progress records; raw material, stores and arrangements. Several useful charts, such as factory orders, job card, progress sheets are listed.

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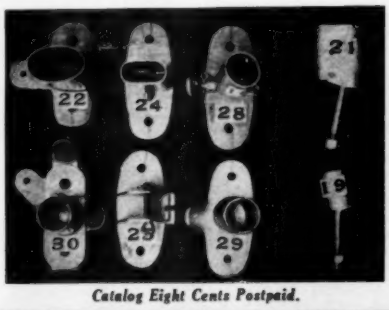

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Causes and Remedies of Airplane Accidents

Lieutenant R. C. Saufley, U. S. N., in the *U. S. Naval Institute Proceedings*, groups the causes of accidents under three heads: air conditions, defects in materials, and personal error. With improvements in machines and an increase in the number of pilots, it is the personal error that is now responsible for a major part of the accidents.

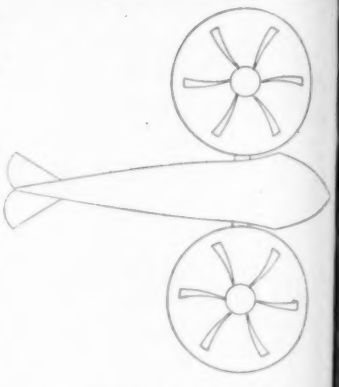
Defects in construction and material can be largely eliminated by a thorough inspection at the factory and on the field. Particular attention is called to crank-case explosions and to poorly made pistons, the walls and heads of which have fractured, causing serious damage. Chain drives are strongly scored as having given trouble in naval practice by jumping the sprockets on a number of occasions.

The present type of stranded wire control is condemned as unscientific and dangerous, and the substitution of heavy wires with bell-cranks or of a rod and lever system is advocated for changing the direction of pull.

Propellers on seaplanes are reported to have been particularly troublesome, as the sheathing is liable to become loosened by corrosion and by the impact of spray, to be ruptured subsequently while in flight. This is dangerous in pushers, where the flying metal may completely sever one of the tail outriggers.

A Suggested Type of Aircraft

In a paper read before the Institution of Civil Engineers of France, A. Brancher presented experiments on a model for a new type of heavier than air machine. As shown in the appended sketch, the model embodies certain features of the standard airplane, but its propelling and sustaining mechanism consists of a number of disks shaped like the blades of certain fans, that rotate rapidly in opposite directions on two vertical shafts.



The experiments have been conducted with an electric motor which gave a speed of from 1,000 to 1,500 revolutions per minute to the disks. When the required speed of revolution was attained the model was set free. It maintained a steady forward and ascensional velocity, and preserved its direction and stability. The model is said to correspond to a full size machine of 10 meters length and a weight of 470 kilograms.

According to M. Brancher such a machine would preserve its stability under all circumstances, chiefly because of gyroscopic action. The author advocates strongly that consideration be given to other types besides that of the triumphant airplane of the present day.

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